Heraeus

Instruction and Operating Manual
Description

CasTemp Wireless including CasTemp Superheat

CasTemp Wireless software V6 onwards

Document Version: 3.5

Date of Issue: 5 June 2020

Electro-Nite

Heraeus Electro-Nite makes no warranties as to the contents of this documentation and specifically any implied warranties of merchantability or fitness for any particular purpose.

Heraeus Electro-Nite further reserves the right to alter the specification of the product without obligation to notify any person or organisation of these changes.

Improvements or instrument changes added after this document was printed are to be found on one or more pages enclosed at the end of this manual. We ask you to take note of these extra sheets.

All instrument boards contain electronic components that can be damaged by electrostatic discharge. These boards should only be handled by qualified personnel. The necessary safety precautions and security guidelines must be observed during maintenance and service on the instrument.

Table of contents

Table of Figures

1 Safety and Usage Notes

1.1 General

This manual provides the information required to use the CasTemp Wireless system. This comprises a CasTemp wireless instrument and a QUBE™ CTW Wireless module. It is written for technically qualified personnel such as engineers, programmers, or maintenance specialists who have been specially trained and who have the specialised knowledge required in the field of instrumentation and control.

This manual is an integral part of the instrument even if, for logistical reasons, it has to be ordered separately. For the sake of clarity, not all details of all versions of the instrument are described, nor can it cover all conceivable cases regarding installation, operation, and maintenance. If you require further information or face special problems that have not been dealt with in sufficient detail in this manual, contact Heraeus Electro-Nite.

We would also point out that the contents of this manual shall not become a part of, or modify, any prior or existing agreement, commitment, or legal relationship. The Purchase Agreement contains the complete and exclusive obligations of Heraeus Electro-Nite. Any statements contained in this manual do not create new warranties or restrict the existing warranty.

1.2 Qualified Personnel

Only qualified personnel should be allowed to work on this instrument. Non-compliance with the warnings contained in this manual or appearing on the instrument itself can result in severe personal injury or damage to property. Qualified personnel includes:

- System planning and design engineers who are familiar with the safety concepts of automation equipment.
- Operating personnel who have been trained to work with automation equipment and are conversant with the content of the manual in as far as it is connected with the actual operation of the instrument.
- Commissioning and service personnel who are trained to repair such automation equipment and who are authorised to energise, de-energise, clear, ground, and tag circuits, equipment, and systems in accordance with established safety practices.

1.3 Danger Notices

The notices and guidelines that follow are intended to ensure personal safety, as well as protecting the instrument and connected equipment against damage.

The safety notices are warnings for protection against loss of life (yours or service personnel) or for protection against damage to property and are highlighted in this manual by the terms and pictograms defined here. The terms used in this manual and marked on the instrument itself have the following significance:

Danger: Indicates that death, severe personal injury, or substantial property damage *will* result if proper precautions are not taken.

Warning: Indicates that death, severe personal injury, or substantial property damage *can* result if proper precautions are not taken.

Caution: Indicates that minor personal injury or property damage can result if proper precautions are not taken.

Note: Indicates important information about the product, its operation, or a part of the manual to which special attention is drawn.

Attention: Hints in this documentation to special safety-related guidelines, which equate to the safety level of Caution and Note.

⚠	This pictogram is used in relation to **Danger, Warning,** and **Caution** notices.

1.4 Proper Usage

- The instrument or instrument components may only be used for the applications described in the manual or the technical description, and only in combination with the equipment, components, and devices of other manufacturers as far as this is recommended or permitted by Heraeus Electro-Nite.
- The instrument described has been developed, manufactured, tested, and the manual compiled in keeping with the relevant safety standards. Consequently, if the handling instructions and safety guidelines described for planning, installation, operation, and maintenance are adhered to, the instrument, under normal conditions, will not be a source of danger to property or life.

1.5 Procedures for Maintenance and Repair

If measurement or testing work is to be carried out on an active unit, your national accident prevention rules and regulations must be observed. Use only suitable electrical tools.

⚠	**Warning:** • Repairs to an item of automation equipment may only be carried out by Heraeus Electro-Nite service personnel. For replacement purposes, use only parts or components contained in the spare parts list or listed in the Spare Parts List section of this manual. Unauthorised opening of equipment and improper repairs can result in loss of life or severe personal injury as well as substantial property damage. • Only use the fuse types specified in the technical specifications or the maintenance instructions of this manual. • Do not throw batteries into an open fire and do not carry out any soldering work on batteries (danger of explosion). Maximum ambient temperature 85°C. Lithium batteries or batteries containing mercury should not be opened or recharged. Make sure that the same type is used when replacing batteries. • Batteries must be disposed of as classified waste.

1.6 Guidelines for Handling Electrostatic Discharge

VLSI chips (MOS technology) are used in practically all Heraeus Electro-Nite electronic modules. These VLSI components are, by their nature, very sensitive to over voltages and thus to electrostatic discharge (ESD).

1.6.1 Electrostatic Discharge

	This pictogram and warning label is used on cabinets, sub-racks, and packing and suggests that modules are susceptible to ESD. Before starting maintenance or installation make sure that you have sufficient protection against ESD.

Electronic devices can be destroyed by voltage and energy levels that are far below the level perceptible to human beings. Such voltages can occur when a component or a module is touched by a person who has not been electrostatically discharged.

In most cases, the components subjected to such over voltages, cannot be immediately detected as faulty; the fault occurs only after a long period in operation.

1.6.2 Shipping of ESD-Sensitive Modules

Anti-static packing material must always be used when storing and dispatching modules and components. If the container itself is not conductive, the modules must be wrapped in a conductive

material such as conductive foam, anti-static plastic bag, aluminium foil, or paper. Normal plastic bags or foil should not be used under any circumstances. For modules with built-in batteries, ensure that the conductive packing does not touch or short-circuit the battery connections: if necessary cover the connections with insulating tape or material.

1.7 Looking After the Instrument

The CasTemp Wireless measurement system requires little maintenance. However, since it is subject to thermal and mechanical stress, it is recommended you check it once a week to ensure accurate results.

1.7.1 Cleaning Notes

The instrument can be cleaned with a damp cloth and mild detergent.

1.8 Packaging the Instrument

Since the instrument is a high-quality electronic measurement unit, it should only be dispatched in its original packing. If the original packing is no longer present, then it is advisable to properly pack the device in a sufficiently large box lined with a shock-absorbing material such as PUR foam, polystyrene flakes, or similar. The shock-absorbing layer should have a minimal thickness of 10cm on all sides. Before packing the instrument, it must be wrapped in paper or plastic film.

1.8.1 Packaging Recommendation

For overseas transportation, the CasTemp Wireless unit should be welded into an air-tight plastic film, ideally with a desiccant added. These packing recommendations also apply when returning the unit to the manufacturer.
The QUBE CTW module contains a lithium-ion battery of energy 9.6 Wh. The module should be packed and labelled in accordance with relevant regulations, noting local variation:

Shipping Mode	Regulations
Air	IATA
Ship	IMDG
Rail	RID
Road	IMDG

Warning
For air travel the QUBE CTW module must be deactivated.

1.9 Safety Regulations

The unit must be connected in compliance with the VDE 0100 "Regulations for establishing high voltage equipment with mains voltages below 1000 V".

Warning
Before opening the equipment, it is essential that the mains voltage is switched off to all channels or that the mains plug is disconnected.

Note that users connected (signalling system, horn) could have their own power supply, which must also be disconnected. Work on live system components may only be carried out with the utmost care by skilled technical personnel.

1.9.1 CE-Declaration of Conformity

The CasTemp Wireless instrument, QUBE CTW module and QUBE CasTip all fulfil the requirements of the following standards of the EU-directives:

- Directive 2014/30/EU concerning electromagnetic compatibility (EMC).
- Radio Equipment Directive 2014/53/EU

Also:

- FCC Title 47 part 15

A copy of the EC Declaration of Conformity certificates can be found in Appendix 1: EC Declaration of Conformity Certificate.
The operating limits are described in Section 0

Critical Safety Information and Section 0

Technical Data.
An entire overview of the QUBE CTW module safety statement can be found in Appendix 2: Safety statement.

1.9.2 Wireless transmitter / receiver module

The Heraeus Electro-Nite CasTemp wireless instruments and QUBE CTW modules work with the industrial transmitter / receiver module RM024 from Laird Technologies, which is approved worldwide. There is a 10mW transmitter in both CTW and instrument. The device is transmitting intermittently for ~100mS, so the energy transmitted is small.

1.9.2.1 RM024 transmitter / receiver module

The RM024 Frequency Hopping Spread Spectrum Transceiver Module from Laird Technologies is a robust and easy to use wireless module. It supports both high data rates and long distances and is used in many machine-machine applications.
• Frequency range: 2400 - 2483.5 MHz
• Transmission distance: 100m (in-door), 1km (free-field)
• Transmission power: +10 dBs

1.9.3 Safety

• Frequency Hopping Radio Interface (Frequency Hopping Spread Spectrum = FHSS)
• System IDs
• Unique IEEE MAC addresses
• Protected Hardware
• Proof, autonomous transmission / reception protocol
• No conflicts with WLAN or WIFI

1.10 RoHS Regulations

All electrical devices sold in the European market from the 1 July 2006 must fulfil the EU Directive 2002/95/EC Restriction of the use of certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) as well as the national laws derived from it. According to the definition in Annex IB of the EU Directive 2002/96/EC WEEE, Heraeus Electro-Nite measuring instruments and analysis devices belong to category 9 - monitoring and control instruments.

All Heraeus Electro-Nite instruments placed on the market after 1 July 2006 do not contain materials prohibited according to the RoHS directive.

Affected parts and components are identified and adapted to the statutory requirements and other substances in those parts and components are utilised where necessary. The quality and usability of our devices are not affected.
The adaptations are usually not visible, although adapted primary housing parts can show different surface colour.

1.11 WEEE Regulations

According to the EU Directive 2002/96/EC Waste Electrical and Electronic Equipment (WEEE), all electrical devices sold in the European market from the 13 August 2005 must be marked with a special symbol. This symbol (crossed out waste disposal receptacle with thick black bar underneath) indicates to the customer that the device must not be placed in household waste, but must be either deposited at a collection place for commercial scrap or returned to the manufacturer.

Heraeus Electro-Nite devices are exclusively for commercial use and may not be transferred to private use. Devices must be disposed of according to the national, statutory regulations for

commercial electrical scrap. You must also follow the EU Directive WEEE regulations and their national conversion. If in doubt, ask your national importer or Heraeus Electro-Nite.

All old Heraeus Electro-Nite devices can be deposited at Heraeus Electro-Nite premises, free of charge and using a certificated disposal company. The customer pays only for the carriage.

1.12 Recycling

If the instrument has to be discarded, think about the following recycling issues. The device consists of several components that can be disposed of separately:

- The electronic cards for electronic recycling.
- The housing for metal recycling.
- The battery for proper disposal

For further recycling information, see section 1.11.

1.13 Residual risks

Risk assessment of the QUBE™ CTW module in the tundish environment has identified three scenarios that could occur when the QUBE CTW module is used outside its operating limits, leading to module failure, which could impact upon personnel. Appendix 2: Safety statement outlines what might be expected in failure and how to minimise such exposure.

2 System overview

2.1 Introduction

The CasTemp Wireless system is an instrument for continuous temperature measurements in continuous casting tundishes and other applications.

Continuous steel casting is a process based on the solidification of steel. A well-controlled steel solidification is the precondition for high quality cast products and caster throughput. Therefore, a real-time temperature is recognised as a key factor in strand quality and casting speed related to the cast steel grade.

The CasTemp Wireless system uses the wireless QUBE CTW module to send real time measurement data from the CasTemp sensor to the CasTemp Wireless instrument mounted nearby..
The CasTemp Wireless instrument then has the possibility to send the results to the plant level 2 computer systems using different interface possibilities.
This means that the:

- Conti-Lab E instrument is replaced by CasTemp Wireless instrument
- Hot- or cold-zone compensation cabling is replaced by the QUBE CTW module
- Other than these changes, all sections in the CasTemp manual still apply
- CasTemp Wireless User Guide describes:
    - All the necessary information to ensure safe operation of the system at all times
    - Mounting of the QUBE CTW module,
    - fitting to the CasTemp sensor.

2.2 Benefits

The benefits of using the CasTemp Wireless system are:

- Simple to install and set up
- Economical: no cable runs to the tundish
- Operate the system in gloved hands with a simple, one-button operation
- Reliable data capture
- Easy-to-read display
- Long battery life with simple battery charging
- No additional complexity of global or local positioning systems
- Same accuracy as the wired CasTemp system
- Modular customizable system

2.3 Components

To allow a customer to begin wireless continuous temperature measurement a minimum number of components are necessary:

- QUBE CTW Module
    - A robust and easy-to-use wireless module connected to a CasTemp sensor
    - Contains a rechargeable Lithium Iron Phosphate battery
- CasTemp Wireless instrument:
    - Contains the receiver, monitors QUBE CTW module output, and can connect to existing plant level 2 systems.
- Charging system for the rechargeable battery
- CasTemp Wireless User Guide

Figure 1: CasTemp Wireless QUBE CTW and instrument Overview shows a schematic of the CasTemp Wireless system in operation

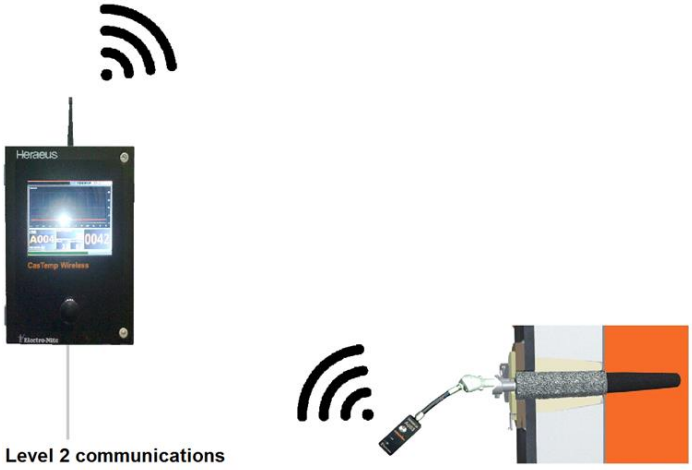


Figure 1: CasTemp Wireless QUBE CTW and instrument Overview

2.3.1 QUBE CTW module

The QUBE CTW module, Figure 2: QUBE CTW module, transceiver unit plugs directly on to the CasTemp sensor and has the following features:

- Compatibility with CasTemp and other Heraeus continuous temperature sensors
- Robust construction for stable operation in environments -20^{0}C to 60^{0}C
- Can be operated with gloved hands
- LED status indication (closed circuit, broadcast, battery, over temperature)
- Programmable data capture rate
- ITS 90 type B thermocouple calibration
- Wireless Interface: 2.4GHz communication
- Rechargeable battery via dedicated USB port connection on the QUBE CTW module
- Long battery life (depends on data capture rate)
- Standard lengths of 1.5m, 3m and 4m are available
- A straight or right angled head (90°) are available

Figure 2: QUBE CTW module

2.3.2 CasTemp Wireless Instrument (CTW)

The CasTemp Wireless instrument, Figure 3: CasTemp Wireless instrument (CTW), controls the QUBE CTW module and displays the liquid steel temperature:

- Wall-mounted in an IP67 housing
- Easy-to-read wide field of view TFT display
- 1:1 pairing protocol: only one QUBE CTW module can be linked to one instrument at a time to maintain location identity (ID) control
- One-button operation
- TCP/IP Ethernet, USB, Serial output ports
    - Optional Profibus and Ethernet IP ports
- Setup and programming of the QUBE CTW module and the CasTemp Wireless instrument using an external keyboard and mouse
- Data storage and download capability via USB
- Remote Viewer capability via TCP/IP Ethernet (with data download functionality)
- Separate power outlet for attaching a dedicated cable for recharging the QUBE CTW module

Figure 3: CasTemp Wireless instrument (CTW)

Figure 4: CTW User Guide

2.3.3 CasTemp Wireless User Guide

The CasTemp Wireless User Guide (Figure 4: CTW User Guide) contains all relevant information for safe system operation:

- Preparation
- Location ID
- Critical Safety Information
- Pairing Conditions
- Measurement Conditions
- Alerts
- Troubleshooting
- Glossary

3 Installing the system

In order to achieve a successful installation, all of the necessary components can be obtained in one CTW STARTER PACK (Figure 5: CTW STARTER PACK). This provides all parts and accessories to allow a customer to begin a wireless continuous temperature measurement. The CTW STARTER PACK comprises:

- x2 QUBE CTW Modules.
- x1 CasTemp Wireless instrument:
- 1 QUBE CTW INST. ACCESSORIES. Associated mounting and fixing accessories pack.
    - contains the instrument mounting plate and all necessary fixings
    - the CasTemp Wireless User Guide
    - CASTEMP SHORTING TOOL
    - CTW CHARGING CABLE

Figure 5: CTW STARTER PACK

Variants of the starter pack are possible based on the length of QUBE CTW module and whether a straight or right handed head is required, see Section 8.3.3 QUBE CTW Module.
A CTW STARTER PACK Assembly Guide (Figure 6 CTW Starter Pack Assembly Guide) and User Guide (Figure 4) are provided with each CTW STARTER PACK.
Personnel training and awareness are critical to ensure ongoing safe and reliable operation.

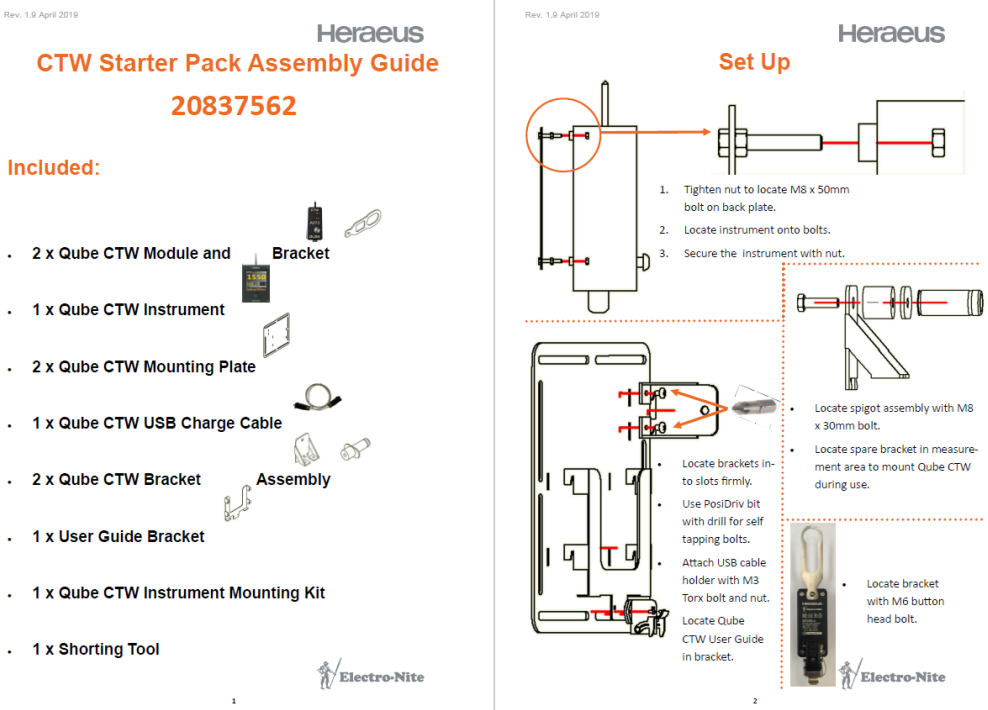


Figure 6 CTW Starter Pack Assembly Guide

3.1 QUBE CTW Module Charging

Charging of the QUBE CTW module can be performed in two ways; using the dedicated power outlet on the CasTemp Wireless instrument or by use of an external QUBE CTW Power Box.

3.1.1 Charging on the instrument

In order to charge the QUBE CTW module battery the following steps are required:

- Ensure QUBE CTW module is not measuring (or alternatively not showing continuity).
- Ensure CasTemp Wireless Instrument charge socket is clean and undamaged.
- Plug in the CTW CHARGING CABLE (Figure 7) as supplied into the dedicated (5V) charging port socket on the underside of CasTemp Wireless instrument (highlighted yellow circle) as shown in Figure 8: Connecting the CTW CHARGING CABLE to the CTW Instrument

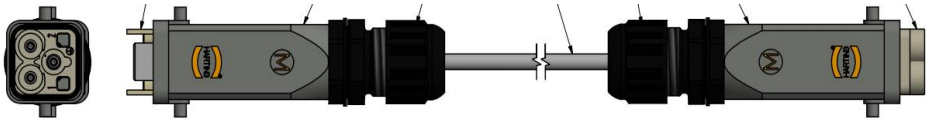


Figure 7: CTW CHARGING CABLE

- **<u>NOTE: USB-A Port is for DATA and communications only.</u>**

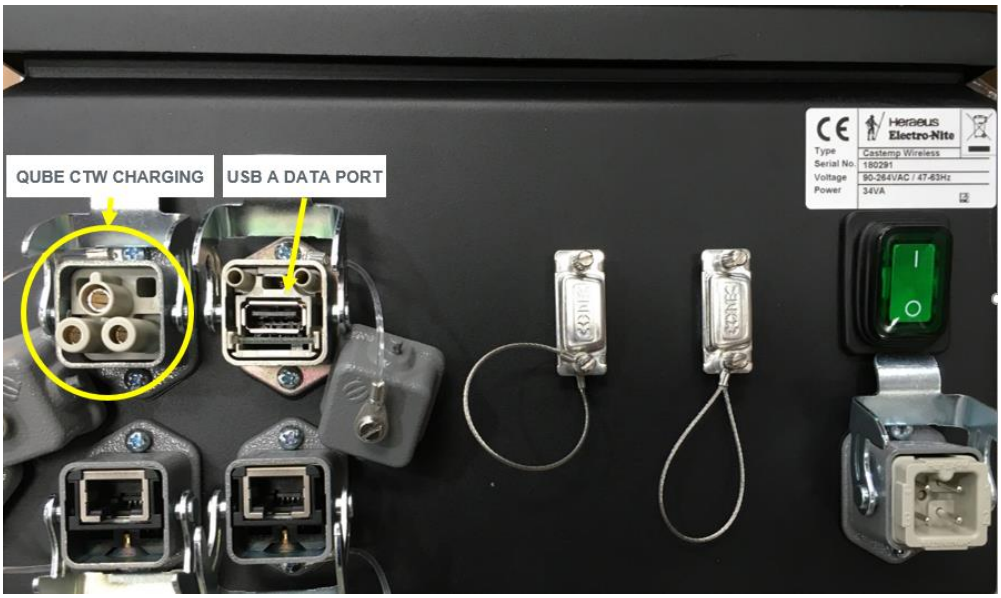


Figure 8: Connecting the CTW CHARGING CABLE to the CTW Instrument

3.1.1.1 QUBE CTW module with USB-A inlet

- Lift up the Harting cover but DO NOT remove.
- Ensure QUBE CTW module charge socket is clean and undamaged.
- Plug in the USB plug end of the CTW CHARGING CABLE into the dedicated USB charging port socket on the QUBE CTW module

Figure 9 shows the assembled instrument mounting plate, CasTemp Wireless instrument and QUBE CTW module in charging position on the mounting plate.

Figure 9: CTW Instrument and QUBE CTW module in charging position on mounting plate

3.1.1.2 QUBE CTW module with USB-C inlet

- Lift up the retaining flap on the QUBE CTW module but DO NOT remove.
- Plug in the USB plug end of the CTW CHARGING CABLE into the dedicated USB charging port socket on the QUBE CTW module as shown in Figure 10

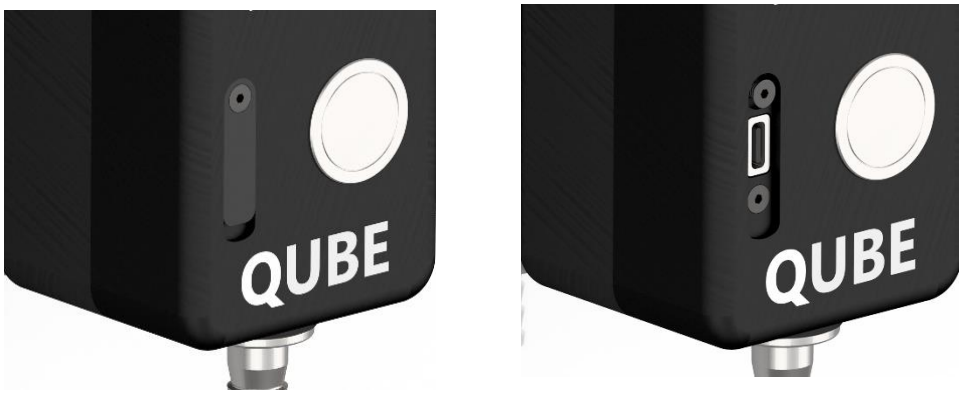


Figure 10: QUBE CTW module with USB-C inlet

NOTE: **For both QUBE CTW module USB-A and USB-C variants:**

- No lights will be indicated on the QUBE CTW module unless the button (shown in Figure 18) is pressed however the battery will be charging.
- If the button is pressed then the battery and measurement LED's are shown as in sections 4.2.2.4 and 4.2.2.4
- The cable can be left connected when the charge level reaches 100%. The software will ensure that the charging circuit is protected and battery level remains topped up.

3.1.2 Charging with the Power Box

A separate charging option is available for the QUBE CTW module which allows charging to be done without the CasTemp Wireless Instrument. Both QUBE CTW module USB-A and USB-C variants can be charged when using the appropriate CTW CHARGING CABLE with the QUBE CTW Power Box

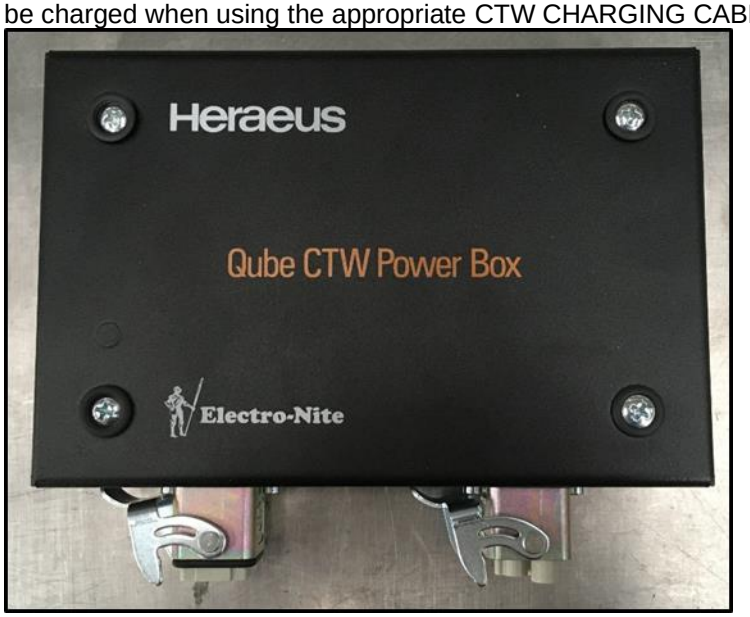


Figure 11: Qube CTW Power Box

Figure 12: Input and Output of Power Box

The power box requires a mains supply of 100-240VAC, 300mA mac, 50/60Hz. The input lead will need to be prepared with the connector supplied in the kit. The output is identical to that of the charging output on the CasTemp Wireless Instrument, meaning the same charging cable can be used. Input and output leads are held in place using retention clips.
Ensure that connectors on both leads and on the power box are clean and undamaged before connecting up.

Figure 13: Retention clips for input and output leads

The Power Box kit comes with a mounting plate and self-tapping screws to allow for it to be mounted in a suitable place.

Figure 14: Power Box mounting plate

3.2 Critical Safety Information

The key to a successful installation is to ensure that the system can operate within its operational limits. This will ensure integrity of the measurement, reliability of the equipment and operator safety: Locate the QUBE CTW module in such a way that it will remain in its operational temperature range.

Temperature Operating Limits		
	Minimum	**Maximum**
Specified	**-20°C**	**+60°C**
CRITICAL (DO NOT EXCEED)	**<-30°C**	**>+85°C**

It may be necessary to shield the QUBE CTW module from direct radiant heat transfer and protect it from molten metal splash.
It is not safe to allow the QUBE CTW module temperature to exceed 85^{0}C.

Site the CasTemp Wireless instrument relative to the QUBE CTW module to maintain minimum mean signal strength. The instrument itself must be protected from direct heat impingement.

Signal Strength Operating Limits		
	Minimum	**Maximum**
Signal Strength	**50dB**	**90dB**

Carry out a risk assessment to ensure that the likelihood of hazard conditions is eliminated through application of suitable control measures. An example of likely hazards and mitigation strategies is given in the table below:

Hazard identification and mitigation		
Caution: Hazards	**Potential Consequence**	**Typical Control Measures**
Temperature Hazards		
QUBE CTW Temperature **< -20°C**	***Below Critical Minimum Limit*** - Loss of Measurement - Reduced battery performance	Increase Qube CTW temperature: - Warm Qube CTW prior to use - Local heating at charging position
QUBE CTW Temperature **< 0°C**	- Unable to Charge Battery	Increase Qube CTW temperature: - Charge in a warm room - Local heating at charging position
QUBE CTW Temperature **> +60°C**	***Above recommended maximum limit*** - Reduced battery performance	-Locate Qube CTW away from sources of heat - Prevent Qube CTW from accidental exposure to sources of heat - Personnel training and awareness
Qube CTW Temperature **> +85°C**	***Above Critical Maximum Limit*** - Loss of measurement - Potential for Battery Failure/ Eruption - Risk of damage to Qube CTW electronics	
Mechanical Hazards		
Tundish Removal before disconnecting Qube CTW	- Hose failure/ Falling objects	- Personnel training and awareness - Automatic Interlocks
Low Signal Strength		
Mean Qube CTW Signal Strength **< 50dB**	- Signal strength sometimes <35dB - Loss of measurement	- Improve positioning of Qube CTW to increase signal strength - Optimise instrument settings
Low Battery		
Charge Level **< 25%**	- Loss of measurement	- Charge when battery light flashes red
Other Hazards		
Stainless Steel Measurement Head **> ~100°C**	- Risk of burns	- Personnel training, awareness and PPE

4 Measuring the temperature

This section describes what has to be done to take a continuous measurement and to pair and unpair the CasTemp Wireless instrument with the QUBE CTW module. The CasTemp Wireless User Guide (Figure 4: CTW User Guide) shows this process and the User Guide should remain close to the CasTemp Wireless instrument in the appropriate holder for ready reference.

4.1 Measurement screen in standard mode

When a measurement is ongoing, the screen of Figure 15: CTW measurement screen Figure 15: CTW measurement screen. The screen contains the following elements:

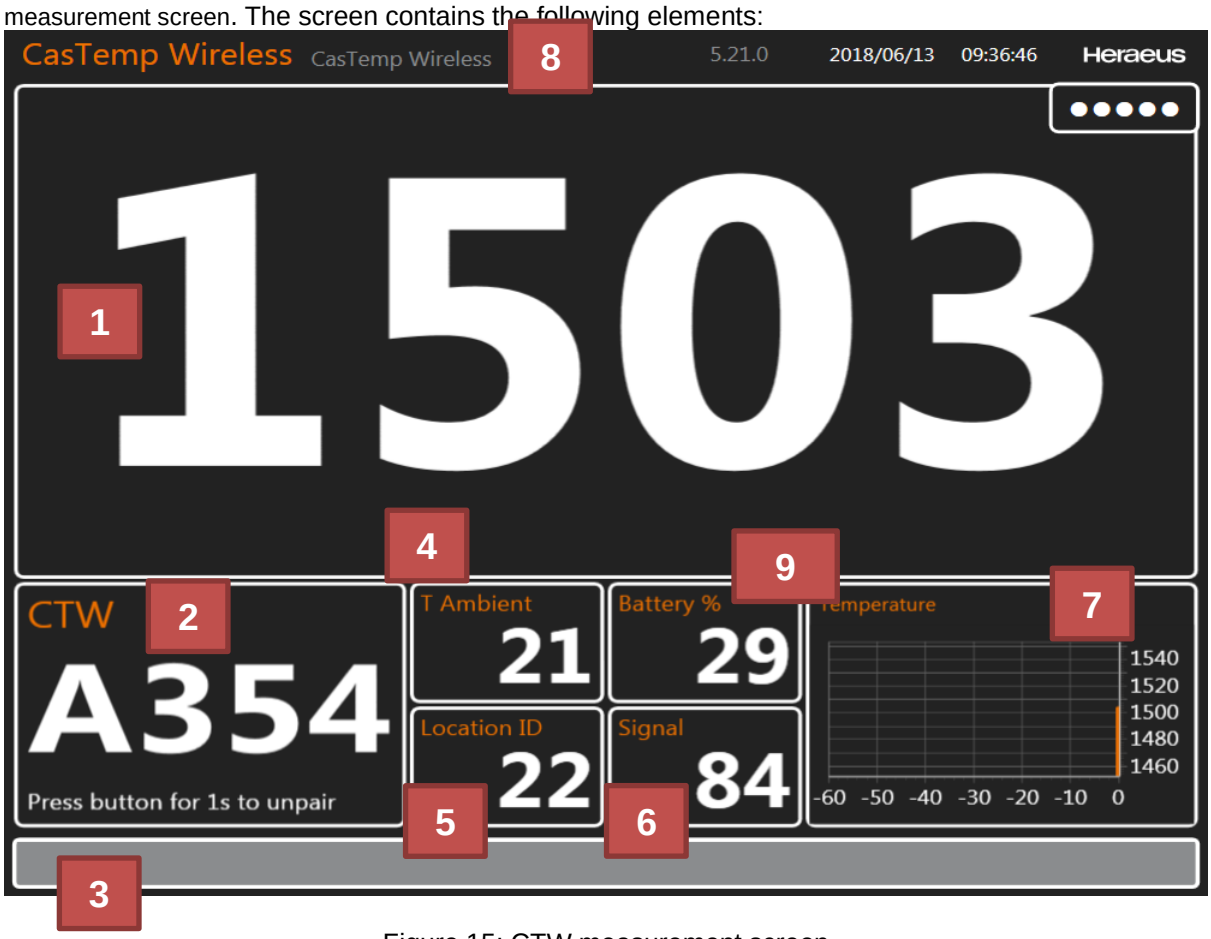


Figure 15: CTW measurement screen

1. Actual temperature of the liquid steel: This is the last measured temperature that is transmitted to the instrument. Transmission rate is fully configurable.
2. ID of QUBE CTW module that is paired with the CasTemp Wireless instrument.
3. Progress bar: This bar indicates when the next message with temperature data from the QUBE CTW module is expected. When the timeout is exceeded, there is no message received and the bar will become red. This indicates a missed transmission.
4. Ambient temperature of the QUBE CTW module.
5. The Location ID of the measurement. This number must be unique for every tundish where an instrument is placed (configurable) and for every Heraeus Electro-Nite Qube system.
    - The local HEN representative can advise on the appropriate settings.
6. The signal strength in percentages of the wireless signal.
7. Temperature evolution graph showing the temperature evolution over the last period (in minutes) (configurable). The graph is updated every time a new measurement is taken.
8. Name of the instrument (configurable).
9. Battery level percentage of the QUBE CTW module

There is a setting to change the view of the measurement window. It is possible to configure the CasTemp Wireless instrument so that the temperature evolution is shown on the top of the screen and the temperature in the bottom right corner as can be seen Figure 16: CTW measurement window with large graph.

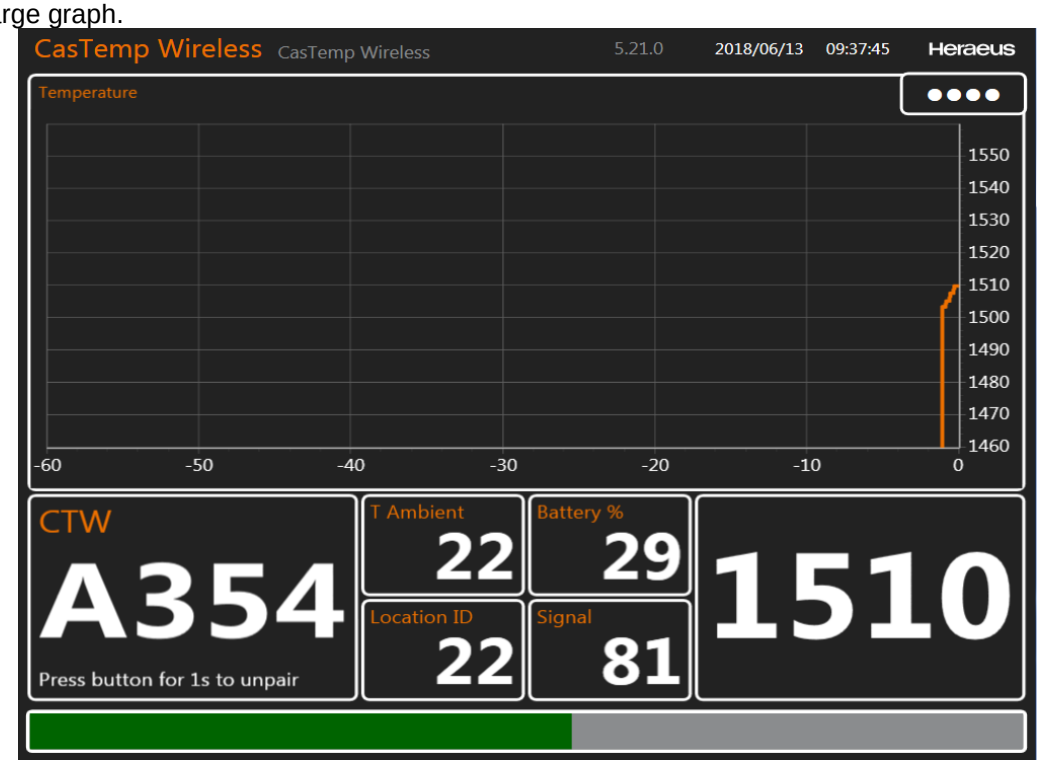


Figure 16: CTW measurement window with large graph

4.2 Pairing and unpairing sequences

To be able to measure the temperature, the CasTemp Wireless instrument has to be paired with a QUBE CTW module that is connected to a sensor. This pairing is unique during the period it is active based on the unique and easy-to-remember module id of the QUBE CTW module.
This section describes the steps to be taken to establish this unique link.
In case the Qube CTW firmware is not compatible with the software this message will be displayed as shown in Figure 17: Incompatible firmware message Figure 17: Incompatible firmware messageand the firmware need to be updated (see section 0

Firmware Upgrade).

Figure 17: Incompatible firmware message

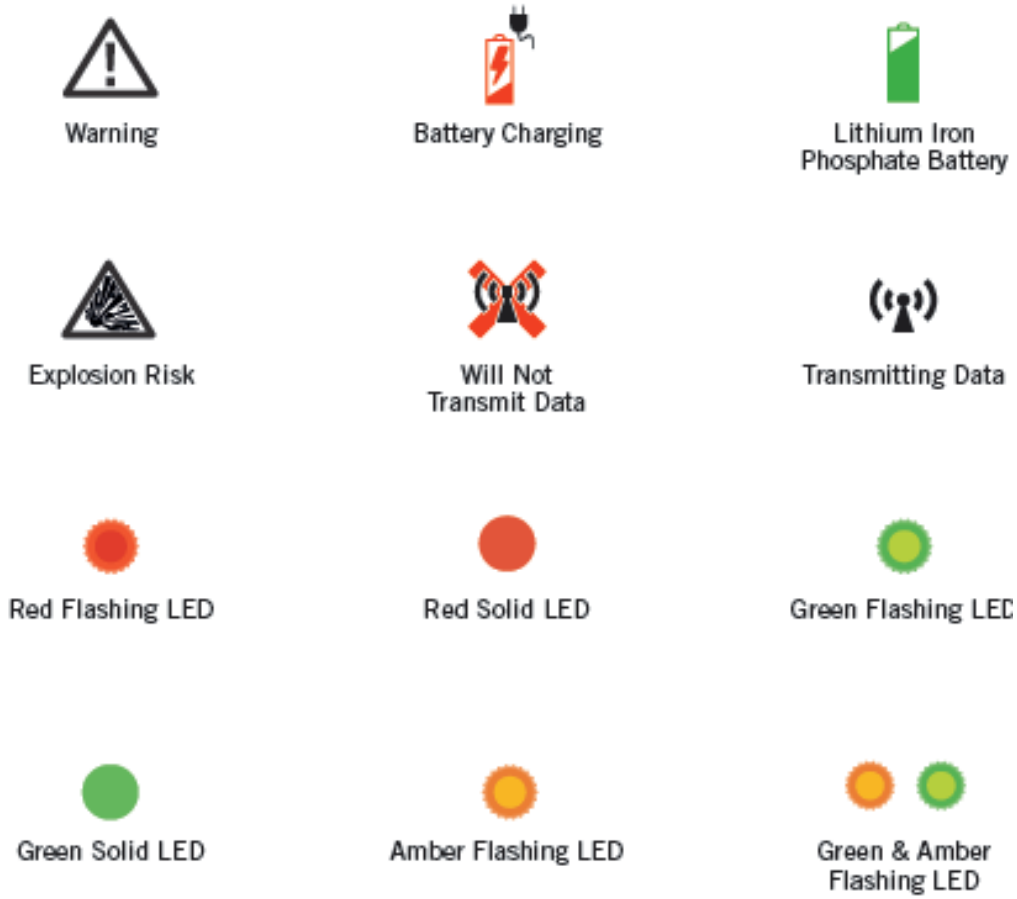
4.2.1 Starting a measurement

This section described the procedure to initiate a measurement. See also the CasTemp Wireless User guide. The following list outlines the conditions and requirements for a measurement:

- Preparation
  - Condition Checklist
  - Charging status
  - Battery LED
  - Measurement LED
- Location ID
  - Each Heraeus Electro-Nite Wireless instrument of any type must have a unique Location ID.
  - This is assigned in settings (section 5.2.2 Configuring the CasTemp Wireless instrument parameters)
- Critical Safety Information as outlined in Section 1.9 Safety Regulations and section 3.2 Critical Safety Information
- Pairing and Measurement Conditions
- Alerts
- Troubleshooting

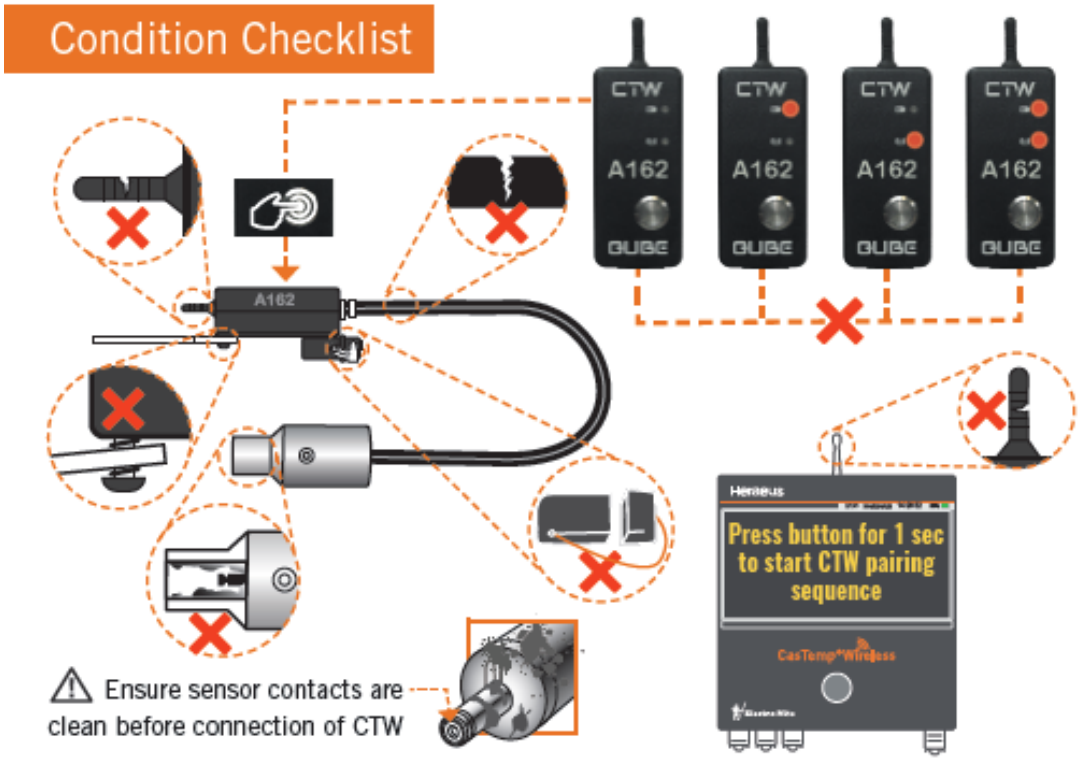
4.2.2 Glossary:

The following pictogram describes the symbols used in the User Guide documentation



4.2.2.1 Condition Checklist

The equipment must be in a safe condition to use. Check for damage and cleanliness particularly where the sensor will connect to the QUBE CTW module.
DO NOT USE if the QUBE CTW module is damaged. The following pictogram identifies most issues:



- Connecting Hose must be undamaged and connected securely at both ends.
- Flashing red lights highlight errors, see User Guide for more information.
- Antenna cover must be undamaged and secure.
- Hanging bracket must be undamaged and secure.
- Contact block must be free from excessive dirt and moisture to avoid shorts.
- Charging cap must be locked closed at all times when not in use.

4.2.2.2 Hard Reset

The above figure shows many methods of troubleshooting the QUBE CTW module. In the unlikely case that the CasTemp Wireless instrument develops a problem the best solution is completing a hard reset. Power down the CasTemp Wireless instrument using the switch on the bottom of the instrument, wait 10 seconds and turn the CasTemp Wireless instrument back on again.

4.2.2.3 QUBE CTW Module Charging

The battery must have a minimum of 10% charge to pair but it is necessary to ensure that there is sufficient charge to last for the length of the proposed sequence. This will depend on a number of factors:

- Frequency of transmit. Based on one transmit per 15 seconds, then a 100% charged will take >3 weeks to fully discharge.
- Cannot pair when in charging mode.
- QUBE CTW module charging procedure is described in section 3.1

4.2.2.4 Battery LED

The battery LED is illuminated once the pairing process is initiated (see section 4.2.2.6). The LED light indicates the charge % as shown in the following table:

Power	LED	
>95%		✓
>25%		✓
<25%		✓
<10%		✗
	As above	✗

4.2.2.5 Measurement LED

The measurement LED is illuminated once the pairing process is initiated (see section 4.2.2.6) and follows on from the battery LED. The LED light indicates the condition as shown in the following table:

Condition	LED
Press & hold for 1 second	
✗ ✗	
✓ ~5kgf ✗	
✓ ✓	
Shut down	

4.2.2.6 Push the button on the QUBE CTW module to send discovery messages

To initiate the pairing process, push the button shown in Figure 18 on the QUBE CTW module to make it discoverable for the CasTemp wireless instrument.

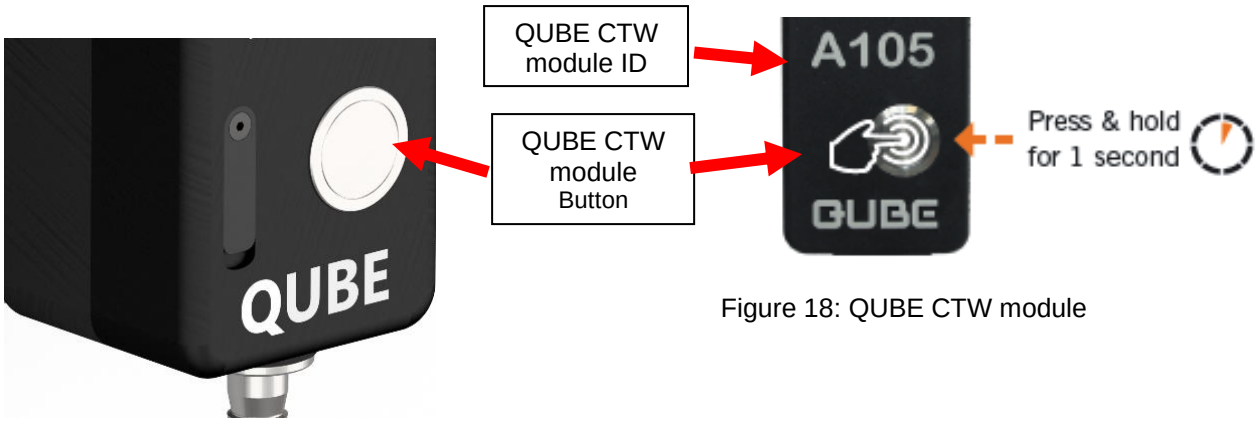


Figure 18: QUBE CTW module

- The red LED next to the wireless symbol will be illuminated for 2 seconds.
- Next the battery LED will indicate the battery level at this moment. If the sensor is connected to the QUBE CTW module, connection with the instrument can be initiated.
- The wireless LED will start flashing green after 4 seconds.

4.2.2.7 Set the CasTemp Wireless instrument in search mode

At start-up, the screen of Figure 19 is shown. No measurement is possible since the instrument is not paired with a QUBE CTW module.

Figure 19: CTW start-up screen

Push the button on the front of the CasTemp wireless instrument for at least 1 second. A progress bar will appear during the pushing.

Figure 20: CasTemp Wireless progress bar

If the button is released after the progress bar is completed, the push action is accepted by the instrument. Note that the progress bar has a different appearance in superheat mode (see section 9.2 Screen differences).
The instrument will now put itself in search mode to detect available QUBE CTW modules. The text of Figures 20 and 21 will appear:

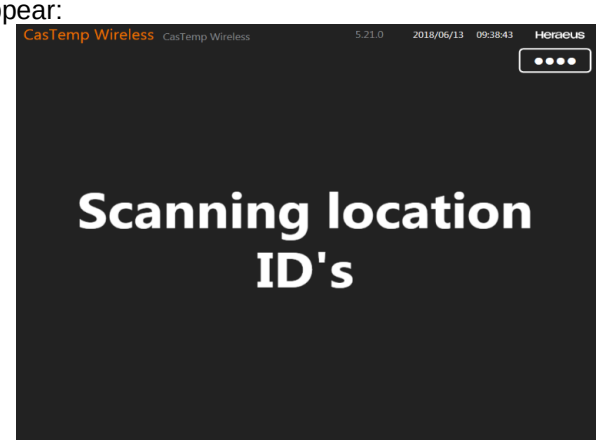


Figure 21: Scanning location ID's

Figure 22: CTW instrument in search mode

4.2.2.8 Accept the QUBE CTW module on the CasTemp Wireless instrument

After some time, the instrument will detect the QUBE CTW module that has been installed and will display its serial number on the screen with the request to accept the pairing (see Figure 23). Accept this module by pushing the button again for 1 second.

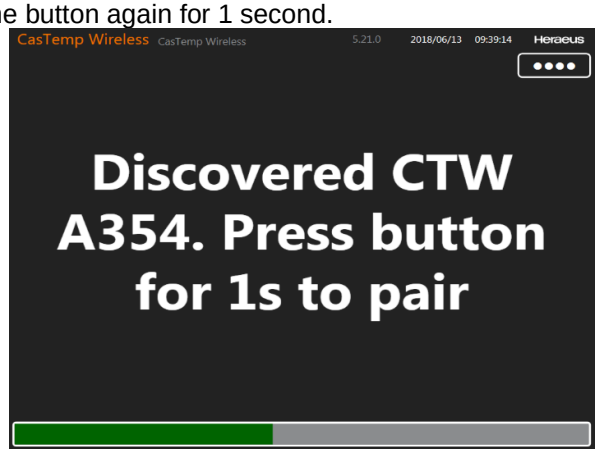


Figure 23: Instrument has detected a QUBE CTW module

4.2.2.9 Confirm the measurement location

The last step is to confirm location of the QUBE CTW module to the CasTemp Wireless instrument. The CasTemp Wireless instrument asks to confirm this by asking to push the button a last time – Figure 24. The serial number of the QUBE CTW module can be found on the module housing (see Figure 18: QUBE CTW module).

Figure 24: Confirm the correct measuring place

After going through the steps described above, the CasTemp Wireless instrument and the QUBE CTW module are linked together. It is not possible for other QUBE CTW modules to interrupt this link, the link is unique and active for as long as both parties (CasTemp Wireless instrument and QUBE CTW module) want it to be active.
The CasTemp Wireless instrument will now show the measurement window as Figure 25 indicates.

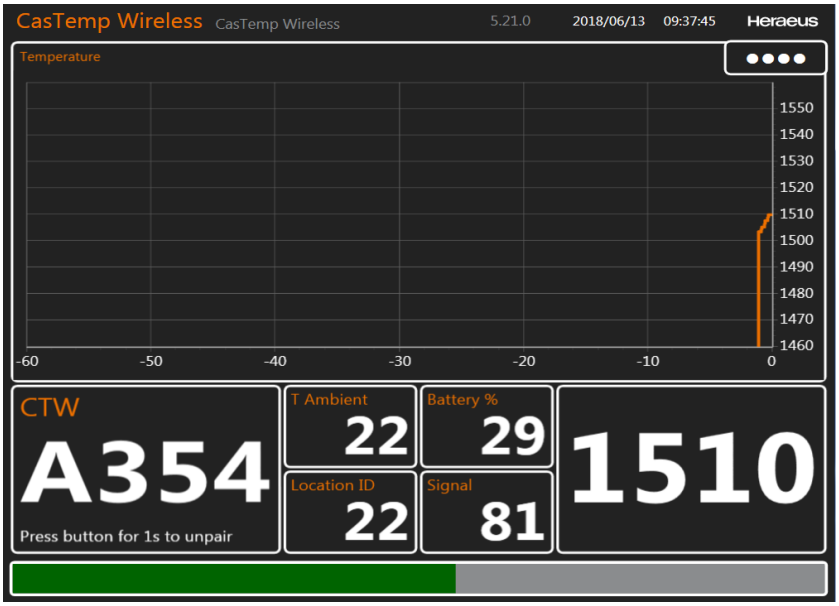


Figure 25: Measurement window after pairing

4.2.2.10 QUBE CTW Module in Measurement Mode

The QUBE CTW module will blink as shown in Figure 26, at the interval set for transmission, see Section 5.2.2 Configuring the CasTemp Wireless instrument parameters – sub section: Measuring period of module.

Figure 26: QUBE CTW module after pairing

4.2.2.11 Pairing safety mechanism

To avoid that the CasTemp Wireless instrument is paired with the wrong QUBE CTW module a number of safety procedures are implemented:

- Only 1 CasTemp Wireless instrument at a time can do a pairing procedure. If the system detects that there is another instrument doing a pairing sequence in the same wireless range, it will not continue in order to prevent from pairing with the wrong QUBE CTW module.
- The text of figure 27 is displayed.

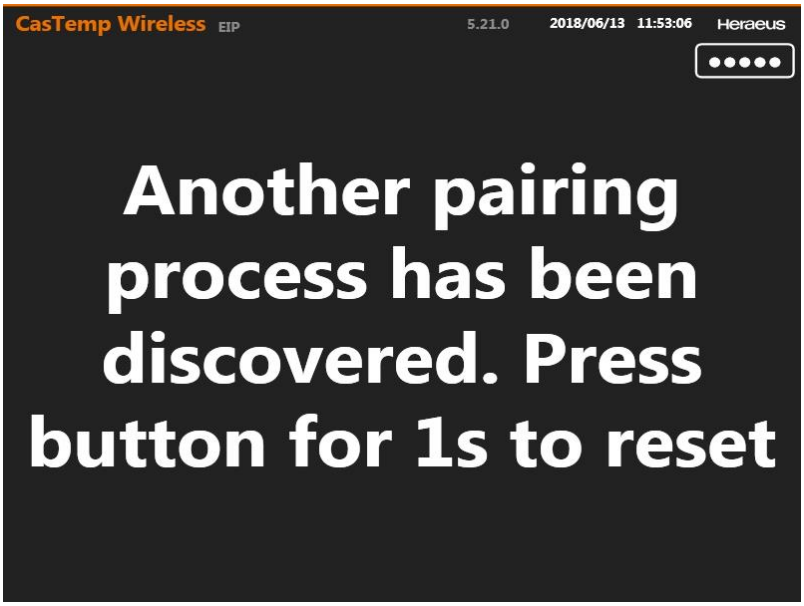


Figure 27: Another pairing procedure is ongoing

- When more than one QUBE CTW module is found actively sending discovery messages, the CasTemp Wireless instrument will report it and refuse the pairing until only one QUBE CTW module is active anymore. This is done to prevent pairing with the wrong QUBE CTW module.
- The text of Figure 28 is displayed.

Figure 28: Multiple QUBE CTW modules detected during pairing

4.2.3 Stopping a measurement

A measurement is ended by breaking the link between the CasTemp Wireless instrument and the QUBE CTW module. There are a number of ways to break this link:

4.2.3.1 Push the button on the CasTemp Wireless instrument

When a measurement is ongoing, the pairing can be broken – and thus the measurement will be stopped – by pushing the button, see Figure 20: CasTemp Wireless progress bar on the CasTemp Wireless instrument (for a minimum of 1 second). The CasTemp Wireless instrument will display the text of Figure 29 to ask for confirmation of the unpairing. After the confirmation, the link between the CasTemp Wireless instrument and the QUBE CTW module is broken and the measurement ends. This feature can be disabled in the settings, see section 4.2.4.Prevent unpairing on the instrument

Figure 29: Confirmation of the breaking of the pairing

4.2.3.2 Push the button on the QUBE CTW module

The link between the CasTemp Wireless instrument and the QUBE CTW module can also be broken by pressing the button on the QUBE CTW module (see Figure 18: QUBE CTW module). The QUBE CTW module will not send any data to the CasTemp Wireless instrument anymore. This will generate a timeout in the instrument and the instrument will return to its start-up state shown in Figure 19: CTW start-up screen. The CasTemp Wireless instrument is now ready for a new pairing sequence.

4.2.3.3 Remove the QUBE CTW module from the CasTemp sensor

When the QUBE CTW module is removed from the sensor, it will no longer send temperature data. The CasTemp Wireless instrument detects that it is not receiving data and reports an open circuit as Figure 30 indicates.

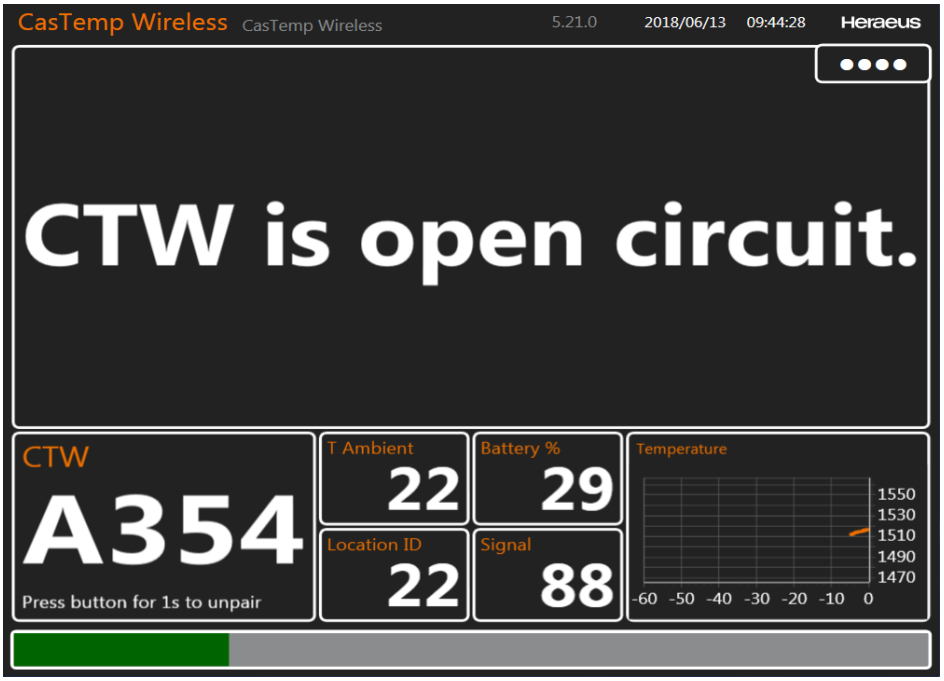


Figure 30: Detection of open circuit

If this lasts long enough, the CasTemp Wireless instrument will break the link between itself and the QUBE CTW module and will go to the start-up state of Figure 19: CTW start-up screen. The maximum number of missed transmissions can be set using the parameter menu (Section 5.2.2Configuring the CasTemp Wireless instrument parameters – sub section: Max. number of missed transmissions).

A CasTemp sensor break will also generate the same report.

4.2.4 Prevent unpairing on the instrument

If configured, (Section 5.2.2 Configuring the CasTemp Wireless instrument parameters – sub section: Operator Can Unpair), it is impossible to break the pairing between the CasTemp Wireless instrument and the QUBE CTW module. This is done to prevent accidental unpairings due to power cuts of the CasTemp Wireless instrument.
The only way to unpair the CasTemp Wireless instrument and the QUBE CTW module in this case, is by pressing the button on the QUBE CTW module (see Figure 18: QUBE CTW module). This generates the timeout as described in sections 4.2.3.2. To speed up the timeout, push the button on the instrument as soon as the instrument misses samples.
A break in continuity by removing from the sensor will also cause unpairing to occur.

5 Configuration of the system

5.1 Configuration possibilities during a measurement

When a measurement is ongoing, a limited number of settings may be changed.
To access the settings window from the measurement window (Figure 15: CTW measurement screen) connect a keyboard and a mouse (via the USB port) so that a window appears on the right top corner (see Figure 31), and type **2448**. The following window will be displayed:

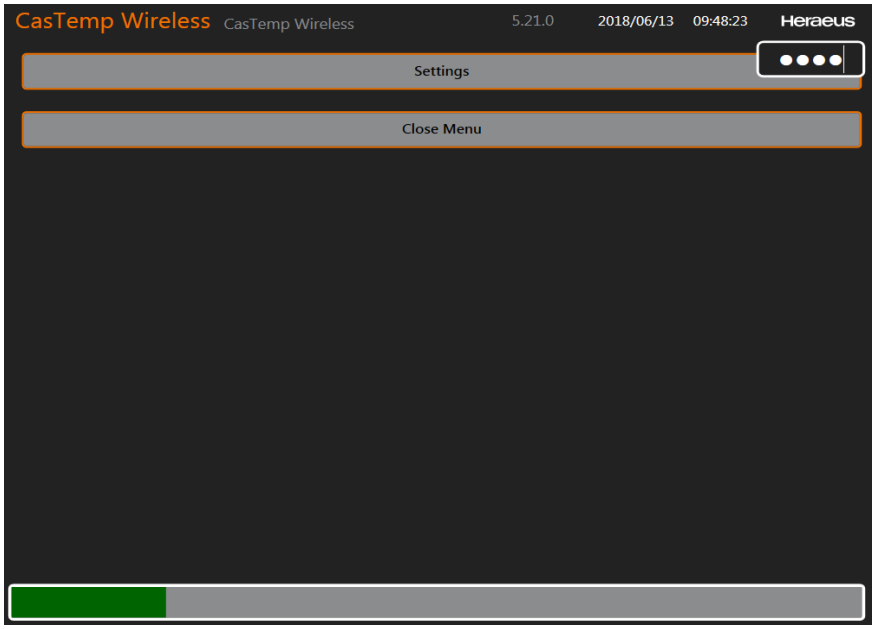


Figure 31: Configuration window during a measurement

Click Settings to adjust some basic parameters of the instrument when a measurement is ongoing. In this mode, only Language, separator and the graph can be adjusted as Figure 32: Basic settings window indicates.

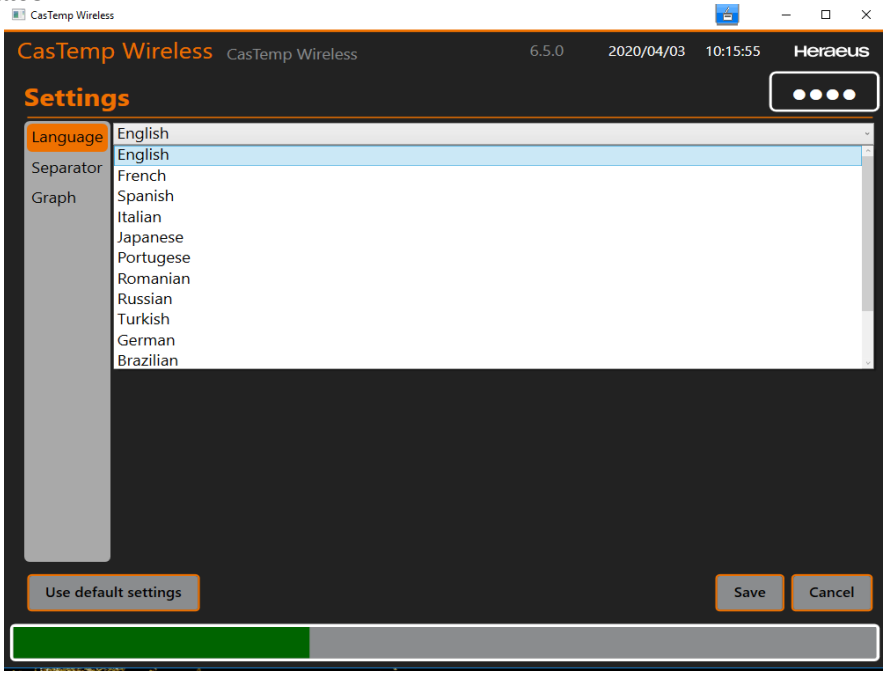


Figure 32: Basic settings window

5.1.1 Editing the Application Language

Use this menu item to adjust the display language of the CasTemp Wireless instrument. This may depend on the software version in use. The following languages are available:

- English (U.K.)
- French
- Spanish
- Italian
- Japanese
- Portuguese
- Romanian
- Russian
- Turkish
- German
- Chinese
- Polish

Click Save to save the selection or Cancel to return to the previous menu.

5.1.2 Separator

This menu item allows changing the separator settings of the CasTemp Wireless instrument. The following parameters can be changed as indicated in Figure 33:

- Separator: (point . or comma ,)

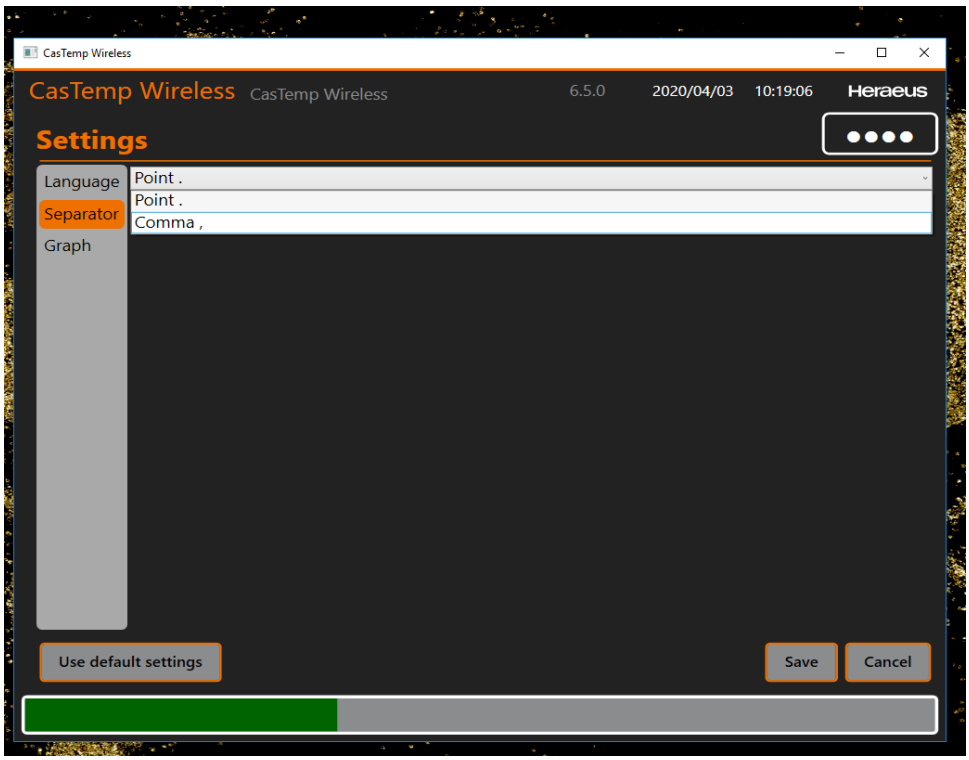


Figure 33: Changing the separator settings

Click Save to save the selection or Cancel to return to the previous menu.

5.1.3 Graph settings

The position of the graph on the screen settings are shown in Figure 34: Changing the graph settings

Figure 34: Changing the graph settings

- Large or small graphs:
  - In standard mode this positions the graph on the main screen or bottom right corner
  - **In superheat mode** (see section 9.2.2) then either the superheat is displayed (small) or the **prediction** screen is displayed (large)

Setting	Default	Comment
Use AutoScale	CHECKED	If this option is selected, the graph autoscales its temperature axis automatically around the last measurement point
X Span	60	The length of the period shown on the graph in minutes. If 60 is selected, the graph will show the temperature history of the last 60 minutes
Y Min	1500	If the autoscale is unchecked, this is the minimum temperature that is shown on the Y axis. The units are the selected measurement units.
Y Max	1600	If the autoscale is disabled, this is the maximum temperature that is shown on the Y axis. The units are the selected measurement units.
AutoScale Value	50	If the autoscale is enabled, this is the autoscale factor. The min and max values of the temperature axis are the last temperature + and – this value. The units are the selected measurement units.
Scale factor	0.75	The current temperature position on the screen relative to the scale of the screen.

Click Save to save the selection or Cancel to return to the previous menu.

5.2 Configuration possibilities when no measurement is ongoing

When the QUBE CTW module is NOT paired with the CasTemp Wireless instrument (or no continuity), a number of parameters can be configured. To access the settings window from the start-up screen (see Figure 19: CTW start-up screen), connect a keyboard and a mouse to the CasTemp Wireless instrument (via the USB port) so that a window appears on the right top corner just below the time and type **24816**.

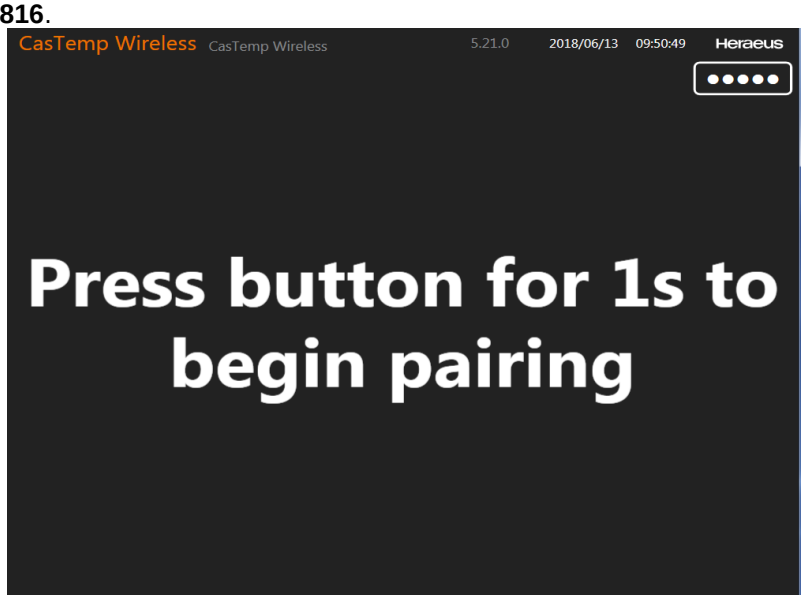


Figure 35: Home screen with login

If this code is entered Figure 36: menu selection window pops up

Figure 36: Menu selection window

Click the Settings button to change the parameters of the CasTemp Wireless instrument. Section 5.1 describes how to configure the language, separator and the graph size. When the QUBE CTW module is NOT paired with the CasTemp Wireless instrument (or no continuity), i.e. no measurement is ongoing, the CasTemp Wireless can be fully configured as described in the next sections.

5.2.1 Configuring the Temperature parameters

There are two settings in the temperature page. Whichever temperature unit you choose will affect the value seen on screen and also the downloaded data.

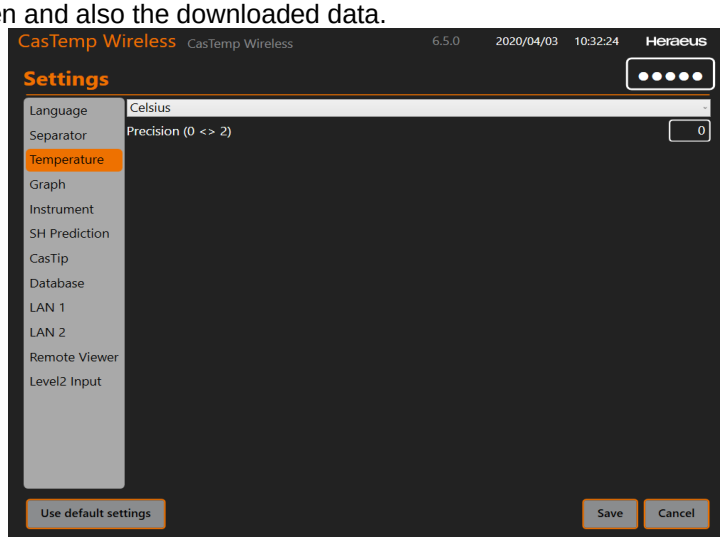


Figure 37: Temperature type screen

Setting	Default	Comment
Temperature	Celsius	Toggle between Celsius and Fahrenheit
Precision: (0 – 2).	0	0 will display whole numbers; 1 and 2 will display with decimal points

5.2.2 Configuring the CasTemp Wireless instrument parameters

This configuration menu contains a number of parameters that have to be set by the plant and parameters that should only be configured by Heraeus Electro-Nite service engineers. Figure 38: Instrument settings shows what is configurable and the following table gives the default setting and purpose.

Figure 38: Instrument Settings

Setting	Default	Comment
Enable superheat application	UNCHECKED	software will automatically check once license is loaded – see superheat section 9.6
Enable master mode	UNCHECKED	only required to be checked when instrument is a master for dual setup – see superheat section 9.7
Enable slave mode	UNCHECKED	only required to be ticked when instrument is a slave for dual setup – see superheat section 9.7.2
Enable QUBE CasTip safety mode	CHECKED	Check this box to enable CasTip wireless safety mode. – see superheat section 9.8.2
Enable QUBE CasTip module lock	UNCHECKED	This box cannot be checked by the user – software will automatically check this box when a module is locked to the system. User can uncheck this box to allow new module to connect to the system. Save settings for module lock do not take effect until Settings menu is completely closed. – see superheat section 9.8.2
Operator can unpair	CHECKED	Check if you want the operator to be able to unpair the instrument through the instrument button.
Name of Instrument	CasTemp Wireless	Optional
Master IP (Slave mode)	GREYED OUT	only required in the dual setup when instrument is a slave – see superheat section 9.7
Location ID	15	see table below for location ID advice
CTW pairing interval	30	This is the length of time once a module has been seen by the instrument that the user has to pair that module.
CTW Searching Interval	60	this is the length of time that the instrument will search for a module once the pairing procedure is started
Measurement Interval	15000	Measurement should be kept at 15000 unless required otherwise. Contact local HEN rep for advice.
Open circuit interval	6000	This is the time between open circuit samples once the first open sample is seen. This parameter is paired with the number of open circuit samples to give a total open circuit unpairing timer.
No of open circuit samples	10	This is the number of open circuit samples the instrument will allow before module is unpaired.
No. of missed transmissions	8	This is the number of consecutive signals the instrument will be allowed to miss before it is unpaired. In this case it would be 8 x 15 seconds = 2 minute before unpairing

Caution:
Ensure each CasTemp Wireless instrument has a unique location ID. Two instruments with the same Location ID, or the same Location ID on another member of the Qube Wireless family may cause interference resulting in connection instability.

Suggested Location ID scheme:

	Plant Area
1-15	Primary Steelmaking
16-29	Secondary Steelmaking
30-38	Continuous Casting
39	Reserved: do not use
41	Open Communication

Example:

Location ID	Plant Area
30	Caster 1 Tundish Car 1
31	Caster 1 Tundish Car 2
32	Caster 2 Tundish Car 3
33	Caster 2 Tundish Car 4

5.2.3 SH Prediction Parameters

SH Prediction parameters are configurable values but should only be changed if advised to by your local HEN rep. with the exception of Superheat overrun time.

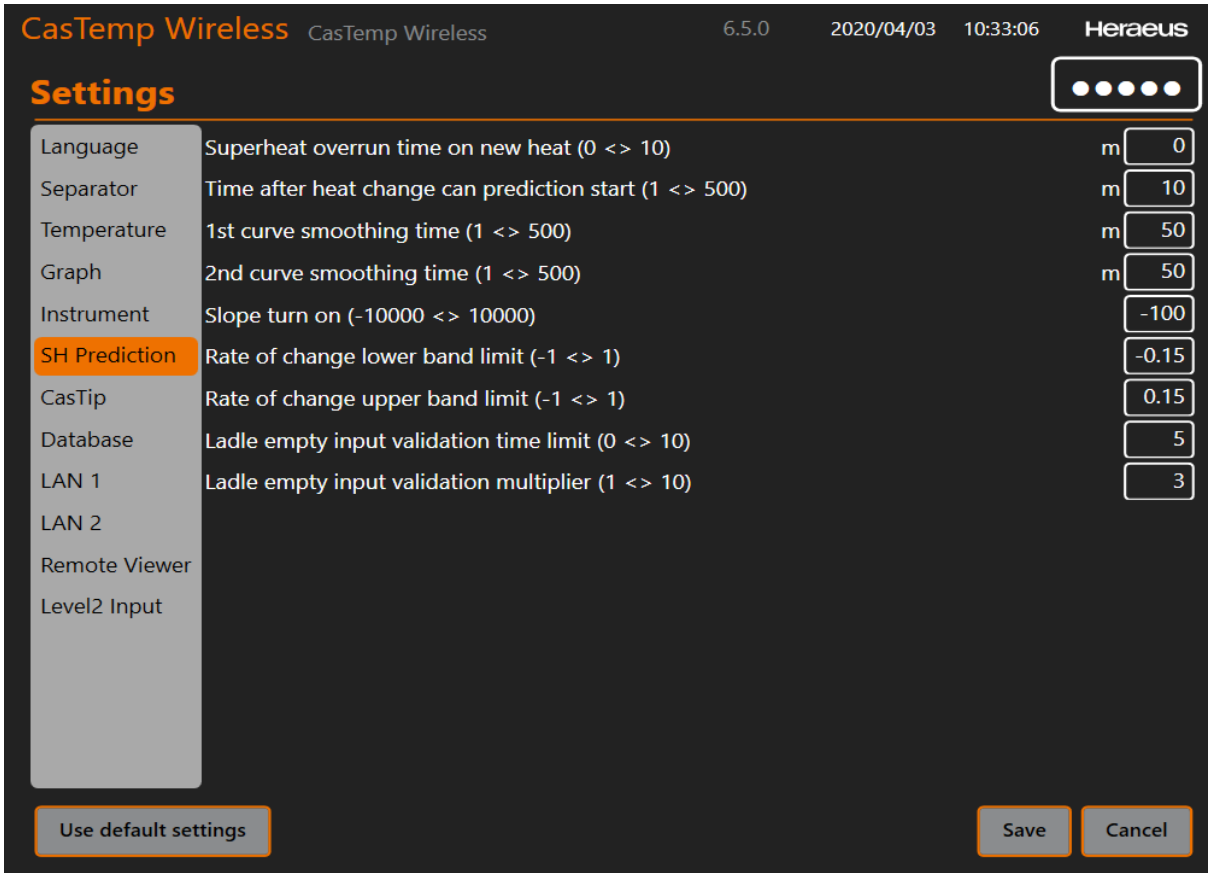


Figure 39: SH Prediction Settings

Setting	Default	Comment
Superheat overrun time on new heat	0	Recommended is 10 minutes to allow contents of tundish to be fully exchanged.

5.2.4 CasTip Parameters

CasTip parameters can be adjusted in order to aid the function of the CasTip. However these should only be changed when advised to by your local HEN rep. with the exception of Checkmate (see section 5.2.5)

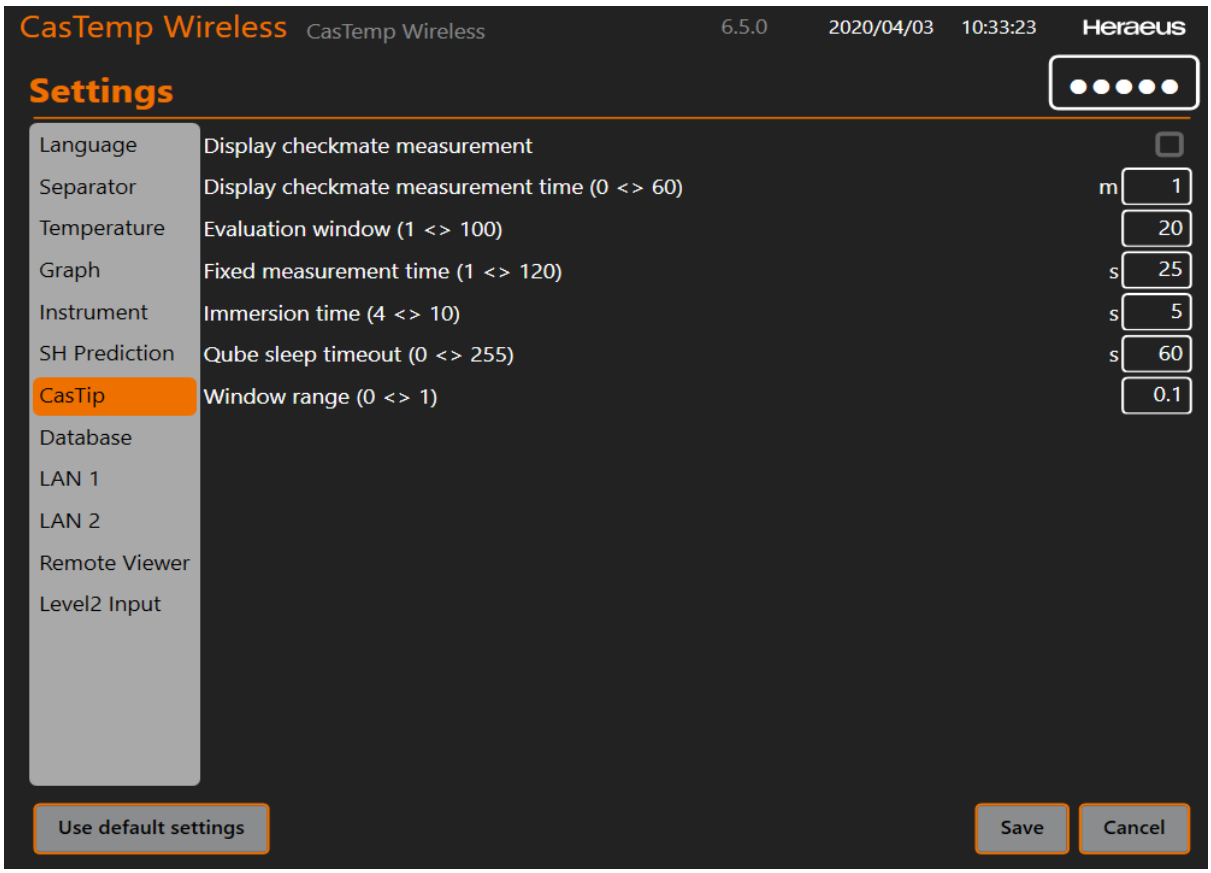


Figure 40: CasTip Settings

Setting	Default	Comment
Display checkmate measurement	UNCHECKED	Check this if you would like the CasTip measurement to be displayed on the SH screen during casting - this will be displayed in yellow for the amount of time set below - this will not be used to calculate SH or run a prediction
Display checkmate measurement time	1	See above
Evaluation window	20	Contact local HEN rep for advice.
Fixed measurement time	25	Contact local HEN rep for advice.
immersion time	5	Contact local HEN rep for advice.
Qube sleep timeout	60	How long it takes for the QUBE CasTip to go to sleep after measurement is complete, set to 0 for the QUBE CasTip to always be awake

5.2.5 Checkmate

The system includes the ability to input checkmate measurements. The CasTemp Wireless instrument has different interfaces to provide communication that can be used to send Checkmate data to the Level 2 system of the plant. The different physical connections available are listed:

- Measurements made on the CasTemp channel will appear as a “normal” fixed value for the length of time the checkmate is connected.
  - There is no current way of distinguishing between CasTemp and Checkmate.
  - As only 1-2 data points may be recorded, because the CasTemp Wireless instrument records every few seconds (configurable, default is 15s) and the checkmate outputs for only a limited time.
- The CasTip input can be checked with the same Checkmate using a different adapter.
  - Once enabled in the software, checkmate measurements will show up as yellow and will be saved to the database but not sent over level 2, and not used for any SuperHeat calculation.
  - If enabled; Checkmate reading will be displayed for time as set in settings
- Both wire calibrations are type B ITS 90.
  - Checkmate adapters are available for Type B continuous measurement.
- Please see your HEN rep for details.

5.2.6 Database parameters

The database parameters are used for the optimal use of the database.

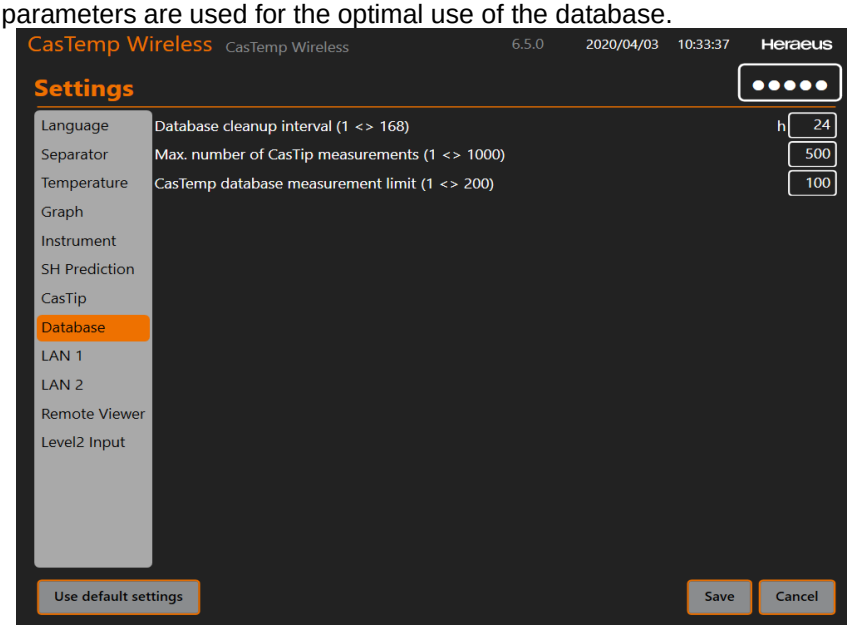


Figure 41: Database settings

Parameter	Default	Comment
Database cleanup interval	24 hours	This is a system parameter that doesn’t need changing
Max. number of CasTip measurements	500	This is the maximum number of CasTip measurements that will be stored by the system. Increase this to save more data.
CasTemp database measurement limit	100	This is the maximum number of CasTemp pairing sequences that will be stored by the system. Increase this to save more data.

Caution:
The database parameters are reserved for Heraeus Electro-Nite Service Engineers only and should not be changed. Changing the database parameters might cause inconsistent and unwanted behavior and is therefore not advised.

5.2.7 LAN 1 & 2 parameters

The network parameters can be viewed when selecting the network option (LAN 1 or LAN 2)

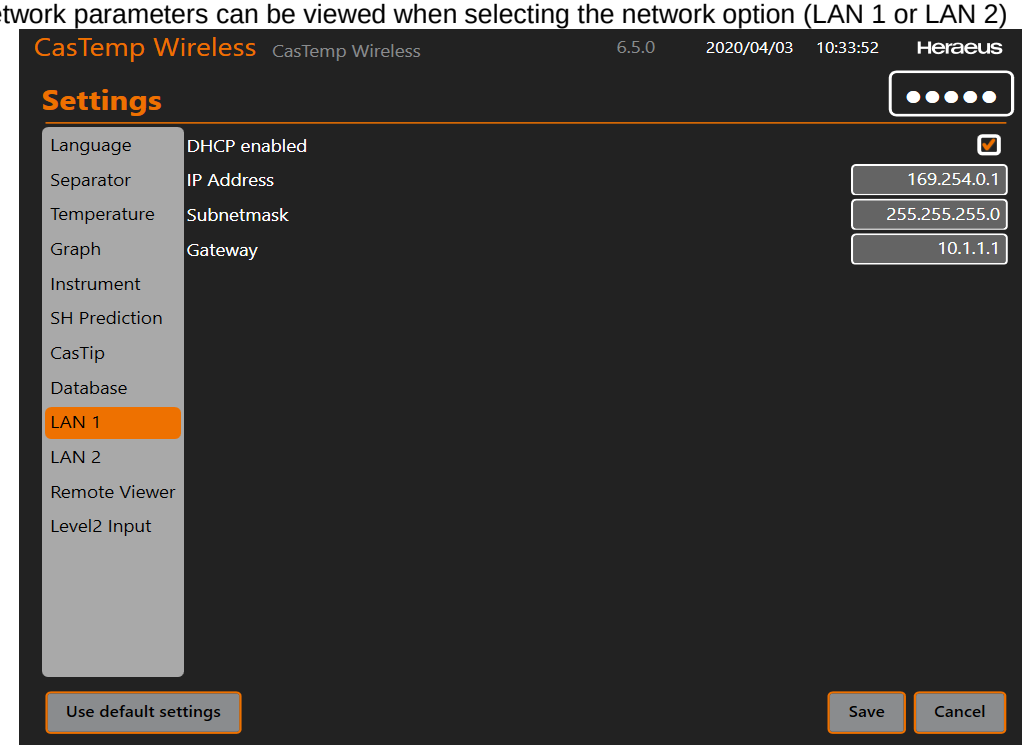


Figure 42: Network settings

The network parameters can only be modified when the DHCP box is unchecked as shown in Figure 43: Network settings with DHCP is unchecked (Not enabled).
Please note that the IP address should only be set once the physical connection is established.

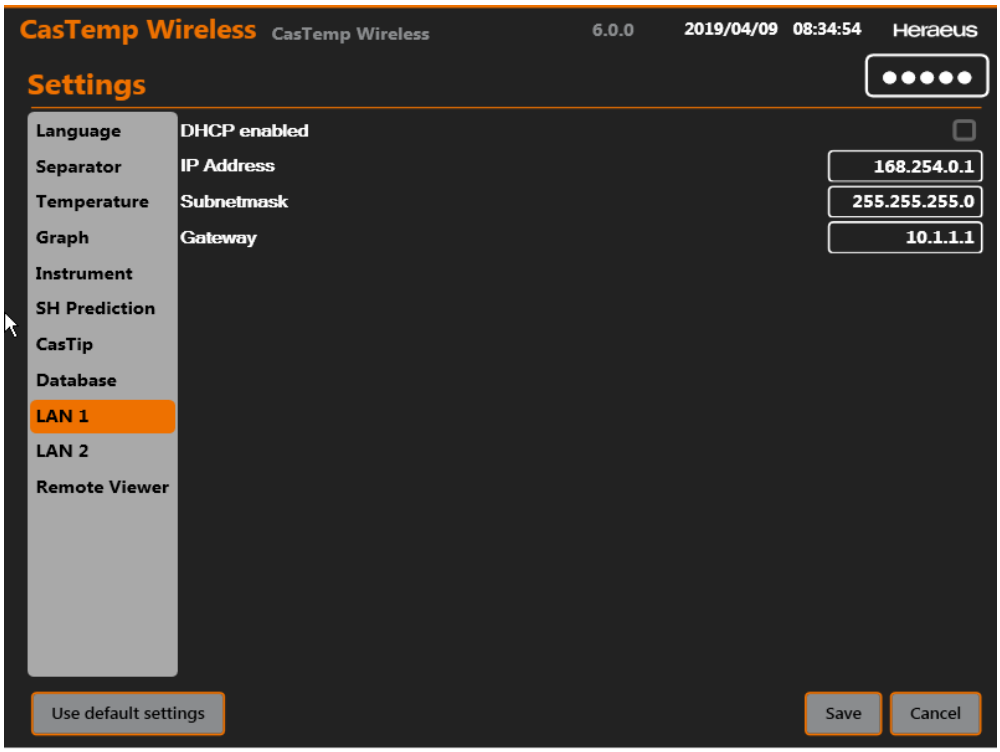


Figure 43: Network settings with DHCP unchecked

The CasTemp Wireless instrument can be placed on a network and viewed remotely. This allows for many different users to view the CasTemp Wireless instrument and download data.

See Appendix 3: Remote Client Installation and set up for details on how to set up the Remote Client Viewer.

5.2.8 Remote Viewer (Meltcontrol Set Up)

The parameters can be viewed when selecting the remote viewer option to enable a connection to Meltcontrol software. Consult the MeltControl manual for further information on connecting the CasTemp Wireless instrument and receiving the data.

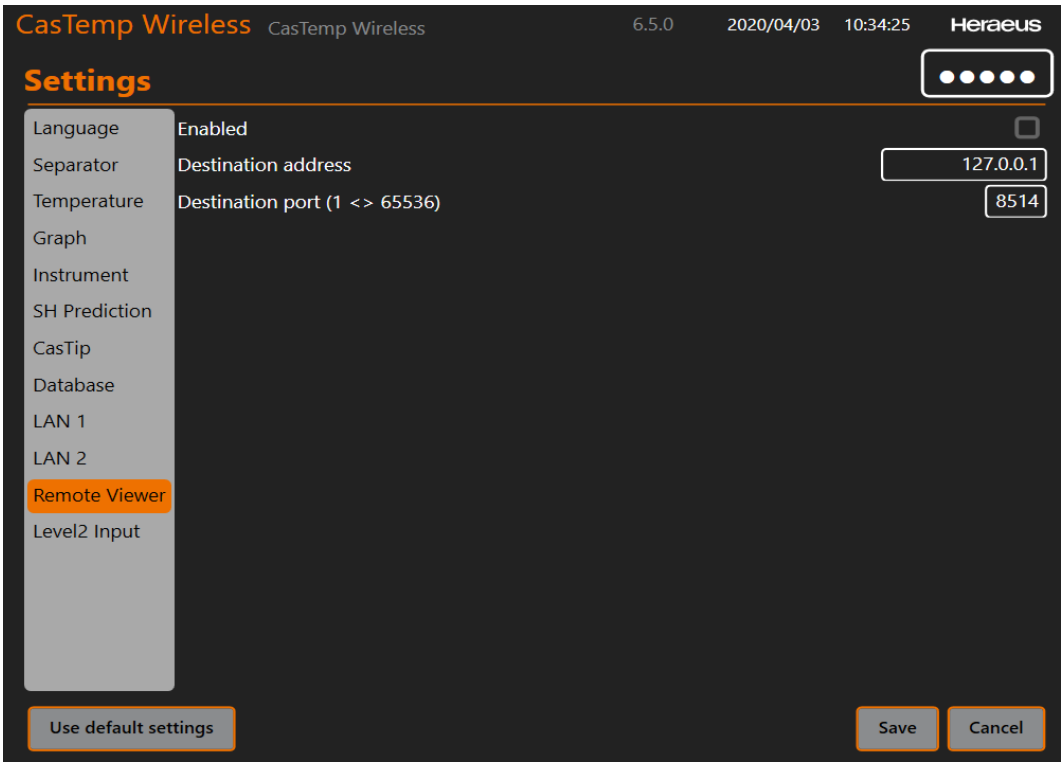
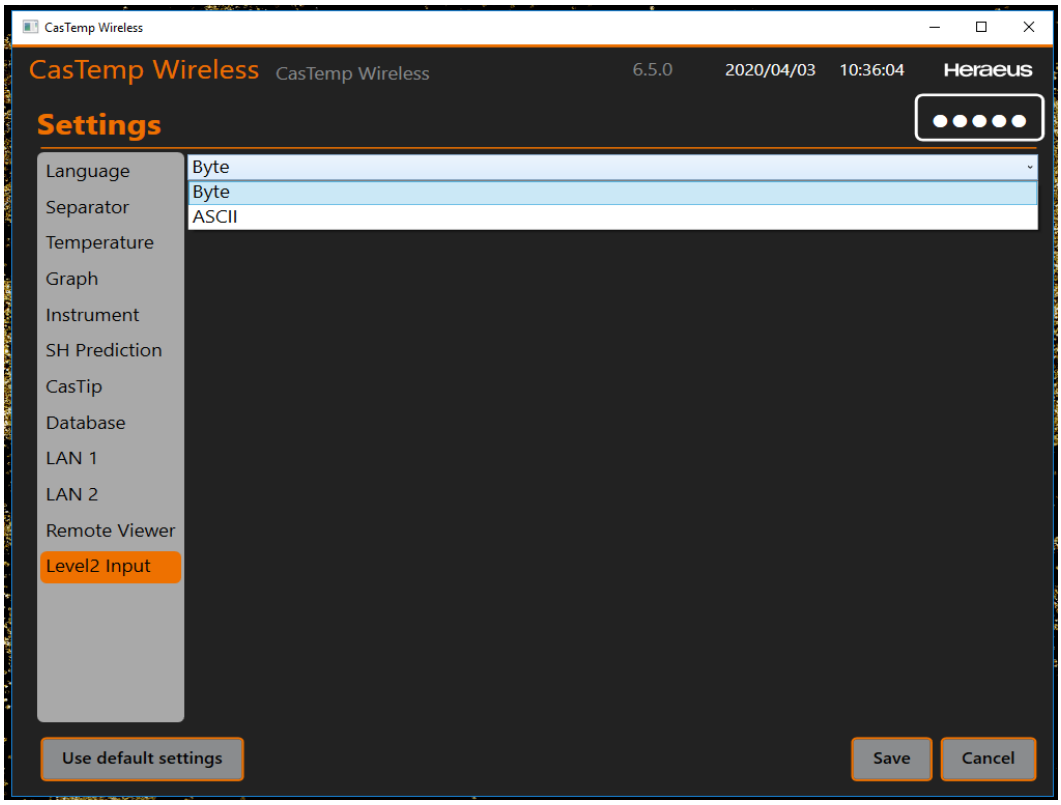


Figure 44: Remote Viewer for Meltcontrol

5.2.9 Level 2 Inputs

The communication over level 2 uses data telegrams.



Each telegram is an array of data following a general structure and each data telegram will contain a header as described below:

Byte	**Field name**	**format**	**Comment**
	Message header		
	Id	Byte	Identifier of the message
	Data count	UShort	The number of bytes in the payload
	Payload		
	Data	Message specific	Message specific data
ASCII	**Field name**	**format**	**Comment**
	Message header		
	Id	1 Char	Identifier of the message
	Data count	2 Chars	The number of bytes in the payload
	Payload		
	Data	Message specific	Message specific data

The CasTemp wireless instrument has to be able to receive the data from the plant.
Data sent from plant to the CasTemp wireless instrument is input data. The direction of the communication is always seen from the point of view of the CasTemp wireless instrument. See section 0

Level 2 communication for information on how to configure the telegrams.

6 Level 2 communication

The CasTemp Wireless instrument has different interfaces to provide communication that can be used to send data to the Level 2 system of the plant. The different physical connections available are listed:

- TCP/IP Server
- TCP/IP Client
- Serial Communication
- Profibus
- Ethernet IP
- Other options are possible. Please contact HEN representative for details.

Profibus and Ethernet IP are not supplied as standard hardware and an option pack is required. The CasTemp Wireless instrument is ready wired for either option. Appendix 4: Profibus and Ethernet IP Module Installation and set up describes the process for this.

The user can configure which data that has to be sent out. Therefore, data telegrams are used. The timing is also configurable. The data telegram is sent at each new sample.

The Level 2 configuration can only be done when the CasTemp Wireless instrument is not measuring. No QUBE CTW module can be paired to the CasTemp Wireless instrument.

Connect a keyboard and a mouse using the USB port of the CasTemp Wireless instrument and enter following code: **24816**. On the right top corner of the screen the login can be done as in Figure 29: Home screen with login

6.1 Telegram composer

After login, the screen of Figure 45 will appear.

Figure 45: Menu selection window

Click the Level2 button to access the Level 2 parameters. The screen of Figure 46 pops up.

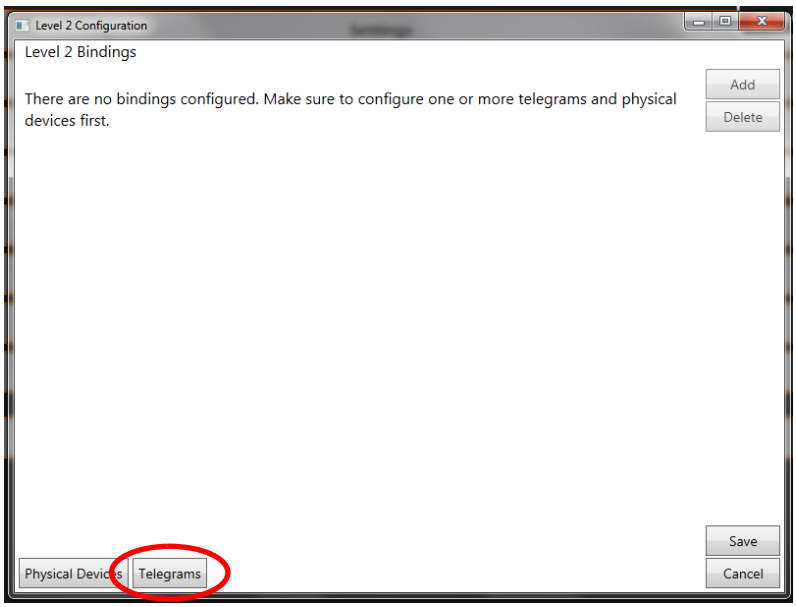


Figure 46: Level 2 configuration window

By default, there are no Level 2 bindings. Meaning that there are no physical devices configured to enable communication.
Click the 'Telegrams' button to go to the telegram composer where the data that has to be sent out can be configured.

To create a new telegram, click the 'Add' button as shown in Figure 47.

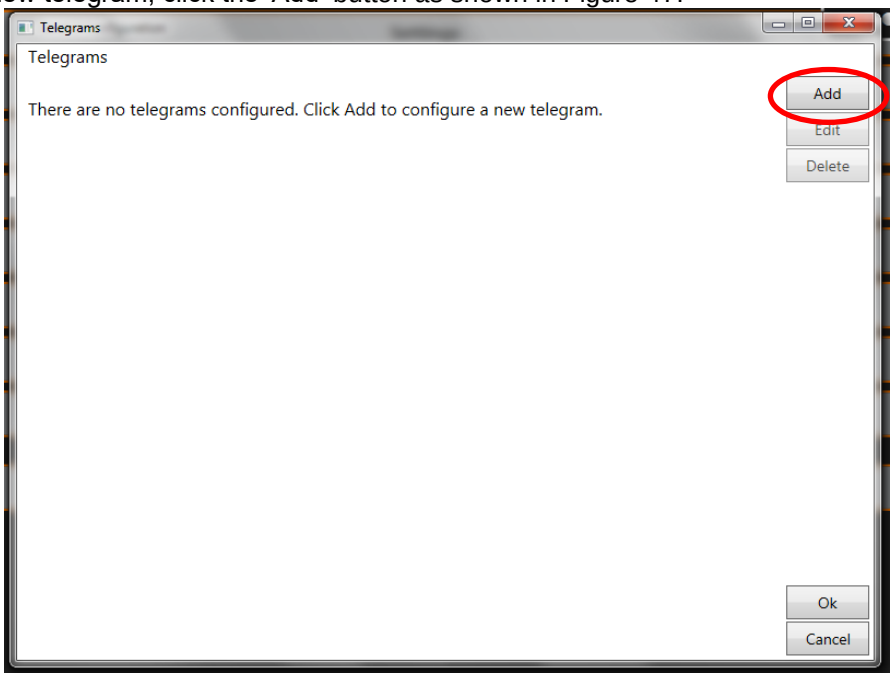


Figure 47: telegram composer main window

The screen of Figure 48 will appear.

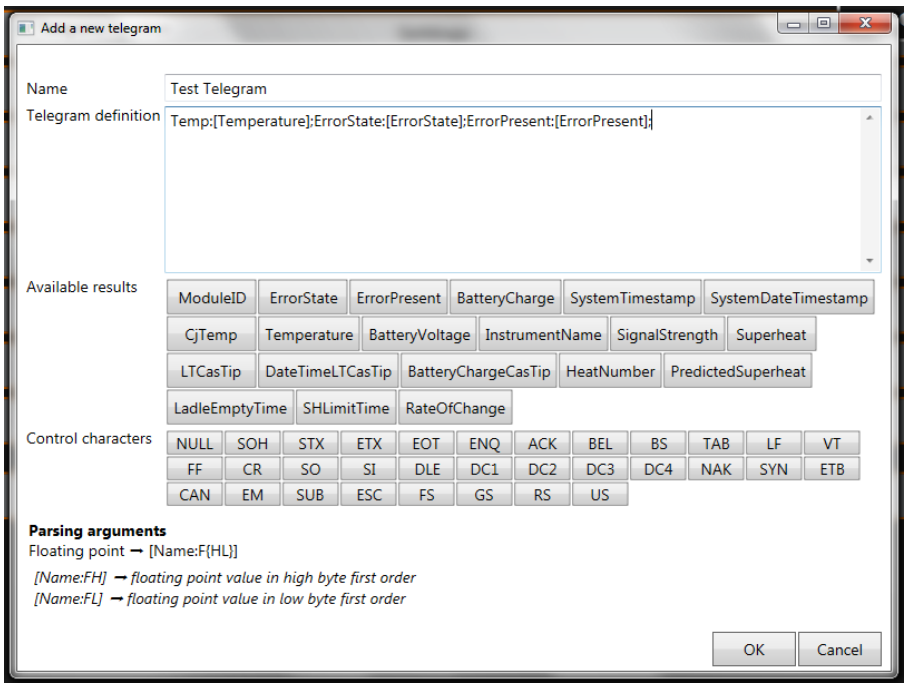


Figure 48: new telegram composer

To create a new telegram, configure the name and the definition.
The name is the name given in the list of bindings; the definition is what is going to be in the data output. Floating point is available on some outputs.
After the new telegram is created, the telegram will be added with the custom name to the list shown in Figure 48 E.g. ‘Test Telegram’
The telegram definition is the data that has to be sent out. A number of predefined fields can be selected from the “available results” field.

The fields that can be selected are listed in

Table **1**.

Table 1: List of available fields in the telegram composer

Field Name	Explanation	Format and Size	Units
ModuleID	The ID of the QUBE CTW module that is paired during the measurement	Text, 4 bytes []	
ErrorState	Equals 0 if no error is active, Equals 8 if an error is active	1 byte	
ErrorPresent[0]	Bit 1 = CTW is open circuit	1 byte	
	Bit 2 = CTW cold junction temperature > 85 °C	1 byte	
	Bit 3 = CTW lost transmission	1 byte	
	Bit 4 = CTW battery charge is critical (charge < 10%)	1 byte	
	Bit 5 = CTW signal strength is critical (strength < 40dB)	1 byte	
	Bit 6 = Reserved for future use	1 byte	
	Bit 7 = Instrument is not paired with CTW	1 byte	
	Bit 8 = Not used	1 byte	
ErrorPresent[1]	Bit 1 = CTW cold junction temperature not in range (-20°C <= x <= 60°C)	1 byte	
	Bit 2 = Reserved for future use		
	Bit 3 = Reserved for future use		
	Bit 4 = Reserved for future use		
	Bit 5 = Reserved for future use		
	Bit 6 = Reserved for future use		
	Bit 7 = Reserved for future use		
	Bit 8 = Reserved for future use		
ErrorPresent[2]	Not currently used	1 byte	
ErrorPresent[3]	Not currently used	1 byte	
BatteryCharge	The remaining charge of the battery of the QUBE CTW module in %	Text, xyz% 4 bytes	%
SystemTimestamp	The timestamp of the measurement as it is recorded by the instrument	Text, hh:mm:ss tt, 11 bytes	(tt = Am or PM)
SystemDateTimestamp	The datetimestamp of the measurement as it is recorded by the instrument	Text, dd/mm/yyyy hh:mm:ss, 19 bytes	
CJTemp	Cold junction temperature	Text, xxx.y , 5 bytes	[degC] or [degF]
Temperature	The temperature measured by the QUBE CTW	Text format, xxxx.y, 6 bytes	[degC] or [degF]
BatteryVoltage	The voltage of the battery of the QUBE CTW	Text, xxxx, 4 bytes	[mV]
InstrumentName	The name of the instrument as it is configured in the settings	Text, 1 byte per character	
SignalStrength	Signal strength of CTW	Text, xyz 3 bytes	

Superheat	superheat value	Text format, xxxx.y, 6 bytes	[degC] or [degF]
LTCasTip	liquidus value	Text format, xxxx.y, 6 bytes	[degC] or [degF]
DateTimeLTCasTip	The datetimestamp of the CasTip measurement as it is recorded by the instrument	Text, dd/mm/yyyy hh:mm:ss, 19 bytes	
BatteryChargeCasTip	The remaining charge of the battery of the QUBE CASTIP module in %	Text, xyz% 4 bytes	%
HeatNumber	Heat number	text, 8 bytes	
PredictedSuperheat	Predicted Superheat	Text format, xxxx.y, 6 bytes	[degC] or [degF]
LadleEmptyTime		8 bytes	
SHLimitTime	Time that CasTemp will cross the critical limit	Text, dd/mm/yyyy hh:mm:ss, 19 bytes	
RateOfChange		6 bytes	

The size of a data telegram is limited to 128 bytes in Profibus.
The user can also select a number of available control characters, for example CR, LF, … The selectable characters are listed in the “Control Character” list. Any ASCII characters can be input using a keyboard. In the example of Figure 48, ‘Temp:’ and ‘;’ symbol were input manually via a keyboard.
Click the OK button to save the data telegram
Accept the protocol, it will now appear in the telegram list.

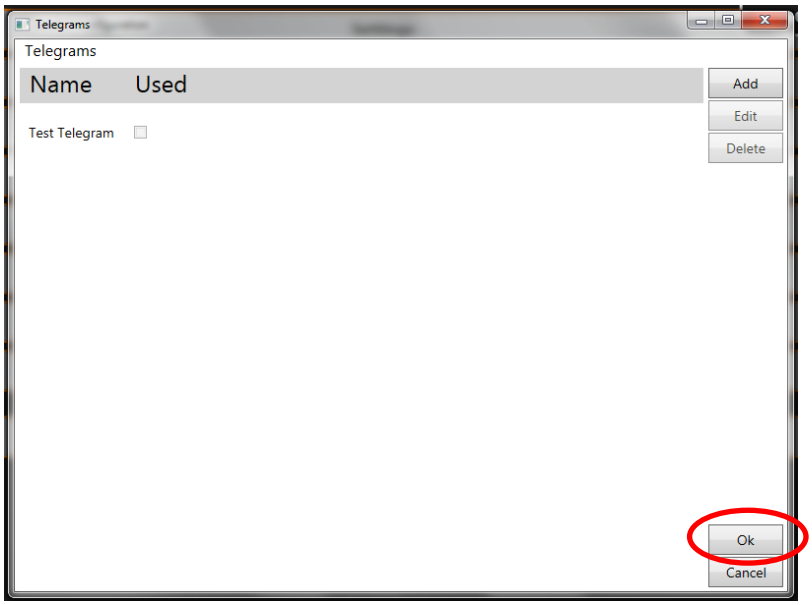


Figure 49: new telegram added to the list

Click the OK button to return to the Level 2 configuration window of Figure 46: Level 2 configuration window

6.2 Implemented protocols

Communication can be done through different interfaces. To configure the protocols for these interfaces, click the 'Physical devices' button in the level 2 composer window which is shown in Figure 50

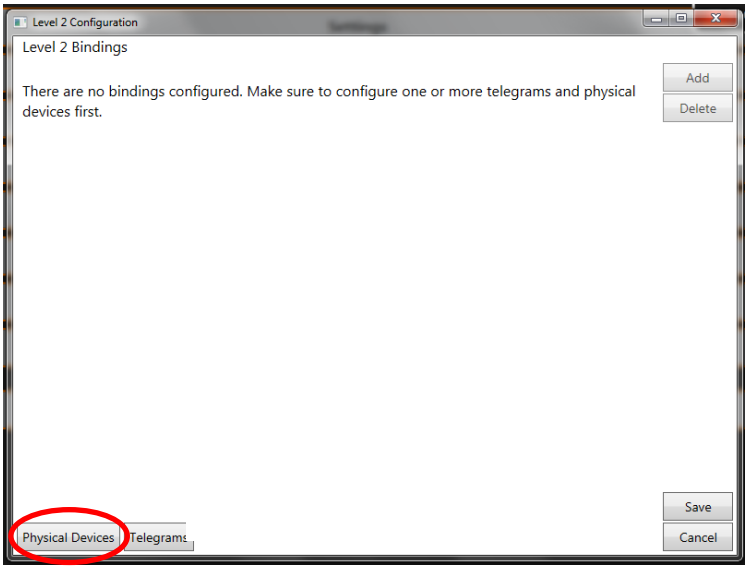


Figure 50: Level 2 configuration window

To add a new physical protocol, select the 'add' button.

As shown in Figure 51, select the correct protocol from the available protocols' list:

- Tcp-Ip client
- Tcp-Ip server
- Serial Device (RS232)
- Profibus (Hms)
- Ethernet IP (Hms)

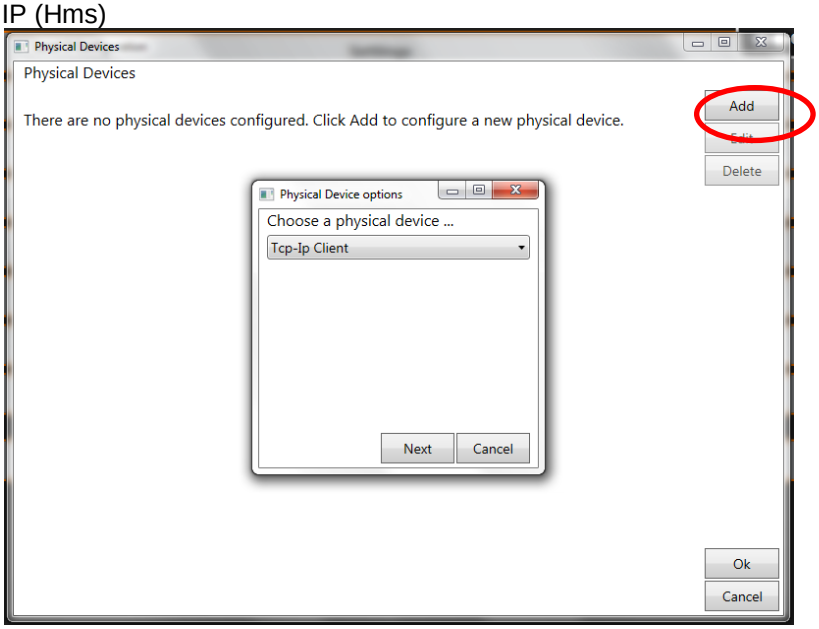


Figure 51: Physical device options

6.2.1 TCP/IP Client

When the TCP-IP client is selected from the physical device options' menu (Figure 50). Figure 52 shows the configuration window after TCP/IP Client is selected.

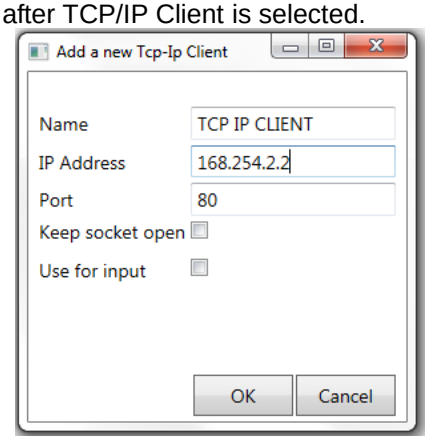


Figure 52: TCP/IP Client configuration

Following settings are user configurable:

- Name of the interface – choose a name that will be shown in the physical device list
- IP Address: server IP Address
- Port: server port to which the client must connect to
- Keep socket open: Client has a permanent connection to the server and does not only connect when it has data.
- Use for input – required for Superheat see section 9.4

6.2.2 TCP-IP Server

The CasTemp Wireless instrument can also be configured as a TCP/IP server. When the TCP-IP server is selected from the physical device options' menu (Figure 50). Figure 53 shows the configuration window after TCP/IP server is selected.
The following settings are user configurable:

- Name of the interface – choose a name that will be shown in the physical device list
- Port: server port that is opened on the CasTemp wireless instrument to which the client must connect to
- Maximum concurrent client connections: the maximum number of clients the server can accept
- Buffer size
- **Use for input – required for Superheat see section 9.4**

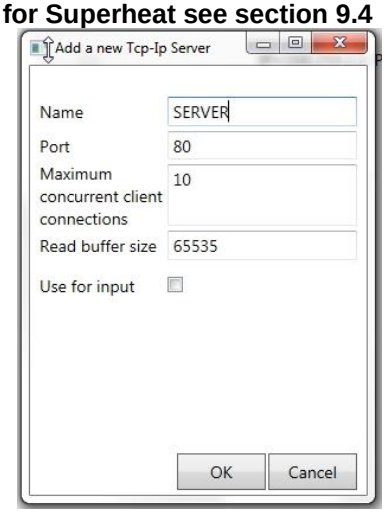


Figure 53: TCP/IP Server configuration

6.2.3 Serial port RS232

The CasTemp Wireless instrument can also be configured as a serial device. When the serial device is selected from the physical device options' menu (Figure 50), Figure 54 appears.

Figure 54: Serial port configuration window

Set the configuration variables to the correct value, as shown in Figure 55
Following settings are user configurable:

- COM port for the serial port: **should always be COM1**.
- BaudRate: speed of the interface, should be the same as the device who receives the data.
- DataBits, StopBits and Parity: should be the same on the receiving side.

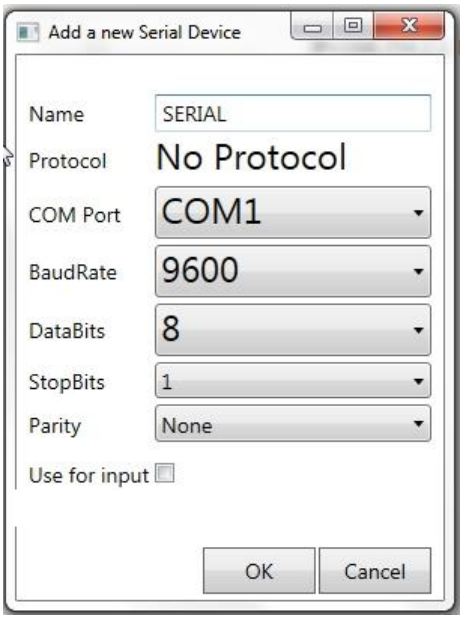


Figure 55: Serial port configuration settings

6.2.4 Profibus

The CasTemp Wireless instrument is also able to communicate using the Profibus interface. To add a Profibus interface, select the Profibus (HMS) interface from the drop down shown in the physical device options' menu (Figure 50), Figure 56 appears.

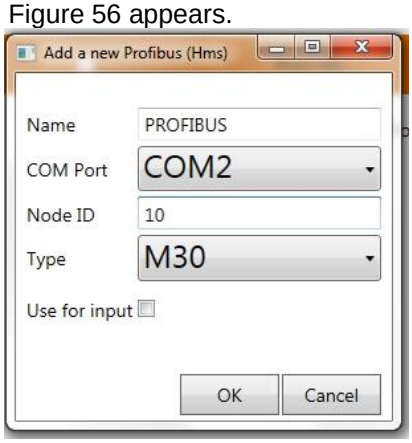


Figure 56: Profibus configuration window

Following settings are user configurable:

- Name: only used for internal instrument reasons
- COM Port: **should always be COM2**
- Node ID: PLC has to know the node ID. Each node ID has to be unique for the PLC.
- Type. Refer to Anybus module card,
- Use for input – required for Superheat see section 9.4

Note: Heraeus Electro-Nite personnel will provide a GSD file for the PLC to configure the Profibus successfully.

6.2.5 EtherNet IP

The CasTemp Wireless instrument is also able to communicate using the EtherNet IP interface. To add an EtherNet IP interface, select the EtherNet IP (HMS) interface from the drop down shown in the physical device options' menu (Figure 50), Figure 57 appears.

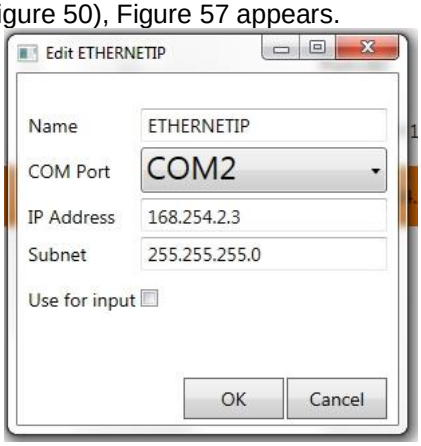


Figure 57: EtherNet IP Configuration window

Following settings are user configurable:

- Name: only used for internal instrument reasons
- COM Port: **should always be COM2**
- IP Address: PLC IP Address
- Subnet: PLC subnet
- Use for input – required for Superheat see section 9.4

An EDS file for the PLC is required to connect and to configure successfully.

6.2.6 Implemented Protocols as Physical Devices List

Click the OK button to accept the new interface and return to the Physical device window it should look like Figure 58:

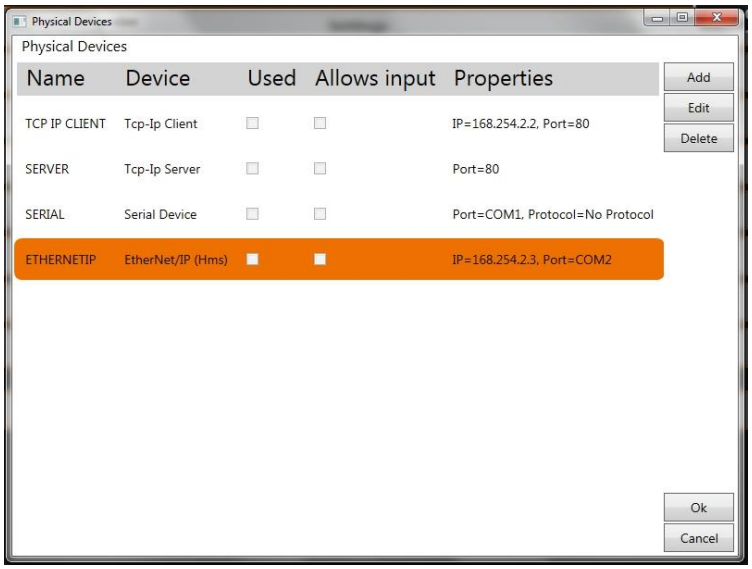


Figure 58: Physical device window after configuring a number of interfaces

Note: It is possible to configure different protocols in parallel sending data telegrams at the same time.

6.2.7 Non standard Protocols

See your HEN representative for details on whether this is possible.eg Profinet

6.3 Bindings between the protocols and the telegrams

To enable communication, the data telegrams must be bound to the physical devices.
As soon as the link is made between the physical interface and the data telegram, the link is active and will start sending data.
To create a link, perform following steps:
Click the ‘add’ button in the level 2 configuration window as shown in Figure 59:

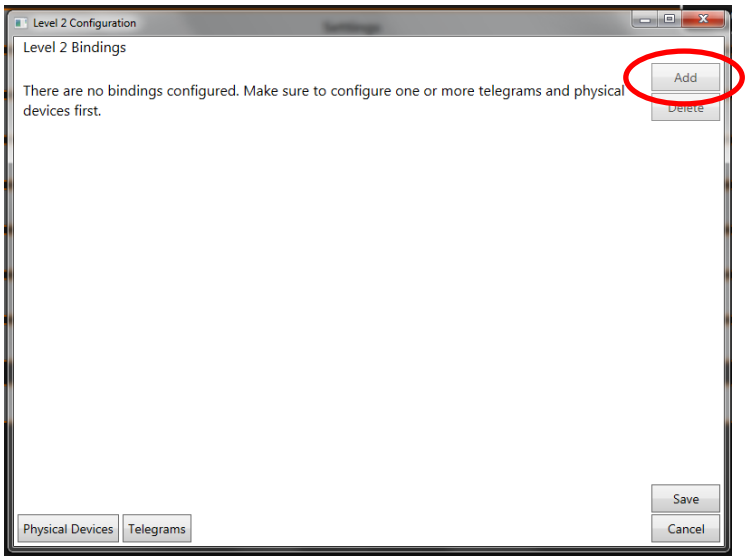


Figure 59: Level 2 configuration window

Give a name to the binding and select the physical interface that has to communicate with the plant level 2 system.
Select the data telegram that contains the data that the physical interface has to send.
Accept the default values in the “Operation” drop down box. Figure 60

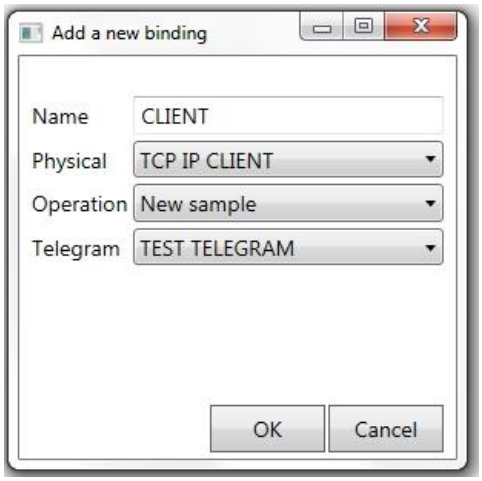


Figure 60: operation window

Telegram Protocol	Operation Type
TCP IP Client / Server	New Sample
Serial	New Sample
Profibus	On Demand
EtherNet IP	On Demand

Select the Telegram from the drop down list as shown in Figure 48 and 49
The newly created binding will now appear in the level 2 configuration window as shown in Figure 61:

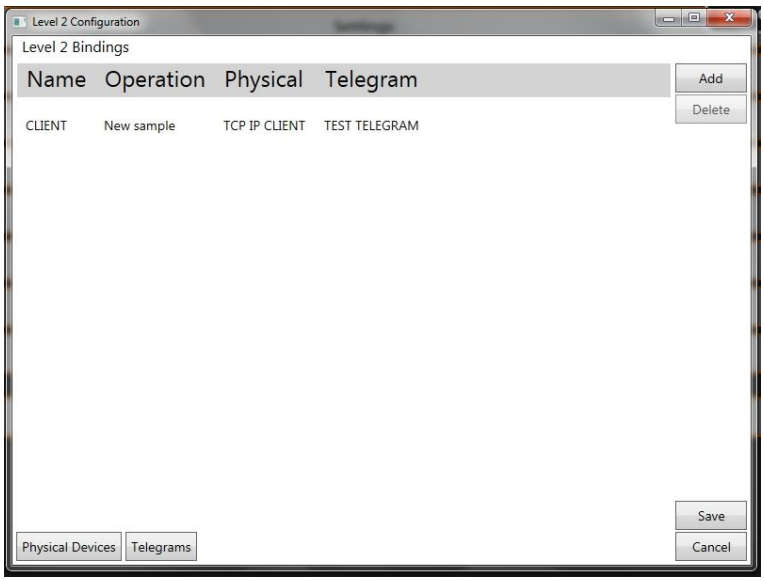


Figure 61: Level 2 configuration window after configuring the telegram and protocol

- Save the settings to ensure data communication.
- **Reboot** the CasTemp Wireless instrument once save is complete.
- If there are editing or changes to the telegram or physical device then delete the bindings and restart the process.

6.3.1 Telegram Output

The following table shows the output of a telegram in the 4 possible conditons: paired; non-paired; loss of transmission or open cicuit.

Telegram Input	Paired		Not - Paired		Loss of Transmission		Open Circuit	
	Character Length	**Output Value**	**Character Length**	**Output Value**	**Character Length**	**Output Value**	**Character Length**	**Output Value**
Instrument Name	16	CasTemp Wireless	16	CasTemp Wireless	16	CasTemp Wireless	16	CasTemp Wireless
Module ID	4	A099	4	UUUU	4	LLLL	4	FFFF
Error State	4	0000	4	…@	4	0004	4	0004
Error Present	1	0	1	1	1	1	1	1
Battery Charge	4	100%	4	UUU%	4	LLL%	4	FFF%
System TimeStamp	11	13:12:45 PM	11	02:57:44 AM	11	13:21:43 PM	11	04:02:35 AM
System DateTimeStamp	19	13/02/2018 11:45:24	N/T	13/02/2018 11:45:24	N/T	13/02/2018 11:45:24	N/T	13/02/2018 11:45:24
Cold Junction Temperature	5	022.4	5	UUU.U	5	LLL.L	5	FFF.F
Temperature	6	1500.1	6	UUUU.U	6	LLLL.L	6	FFFF.F
Battery Voltage	4	3323	4	UUUU	4	LLLL	4	FFFF
Signal Strength	3	081	3	UUU	3	LLL	3	FFF

7 Other

The CasTemp Wireless instrument has a number of other features that can be accessed by the 24816 code. After login the following screen will appear

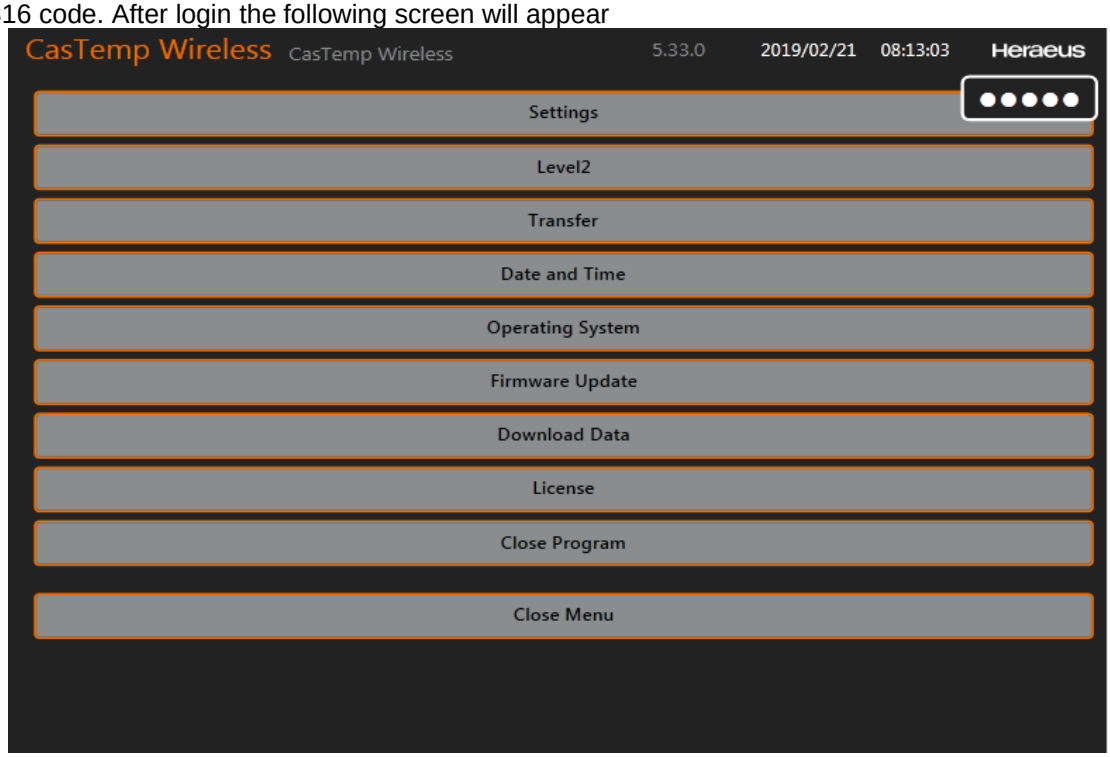


Figure 62: Settings' Menu

7.1 Transfer (of Settings)

The CasTemp Wireless software can save all the settings of the instrument on to a USB memory stick. This will save both the CasTemp Wireless and CasTemp Superheat software settings inclusive of the level 2 settings. This feature makes changing an instrument out straightforward and avoids inputting the settings incorrectly.
The transfer settings screen looks like:

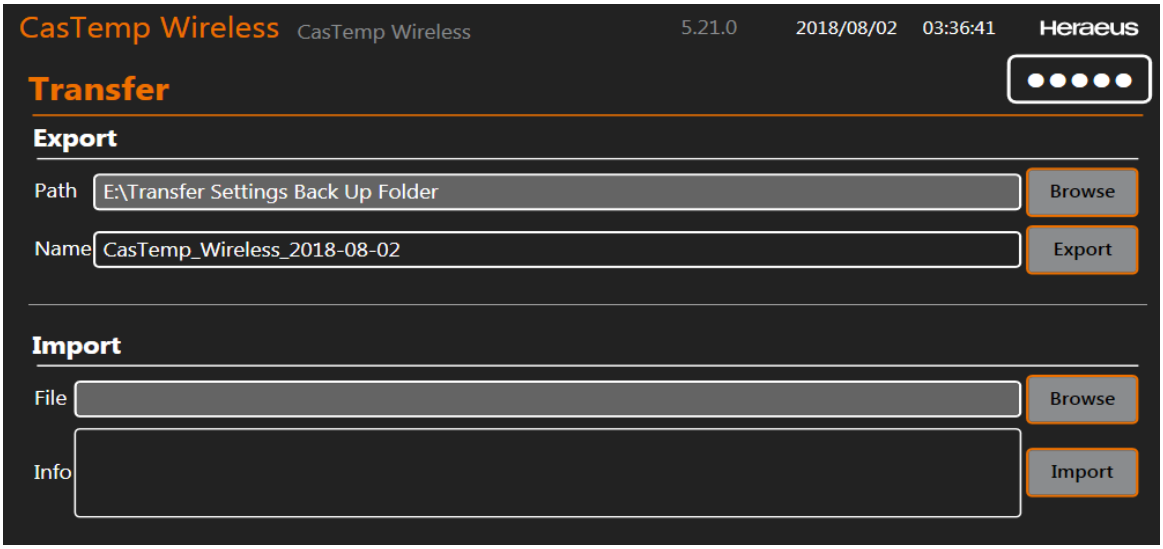


Figure 63: Transfer of Settings

7.1.1 Exporting an Instrument settings

The process of export of an instruments settings is:

- Gain access to the menu via the “24816” menu when unpaired and click the “Transfer” option on the menu
- Name the file, set the location path to the relevant location (usually USB memory stick) and click Export

7.1.2 Importing an Instrument settings

The process of importing instruments settings is:

- Gain access to the menu via the “24816” menu when unpaired and click the “Transfer” option on the menu
- Click “Browse” and find the **.cws* file you would like to import, click “Import” and wait for the operation to complete.

7.2 Operating System

Click the Operating System button to access the instrument operating system. The screen of Figure 64 pops up:

Figure 64: Operating System window

This allows access to the instrument operating system Command prompt.
Command prompt can be used to test the following:

- Instrument IP address
- Connection to other instruments/systems
- Access to file explorer
- Access to control panel

Obtain the local instruments IP address by typing “ipconfig” and pressing enter

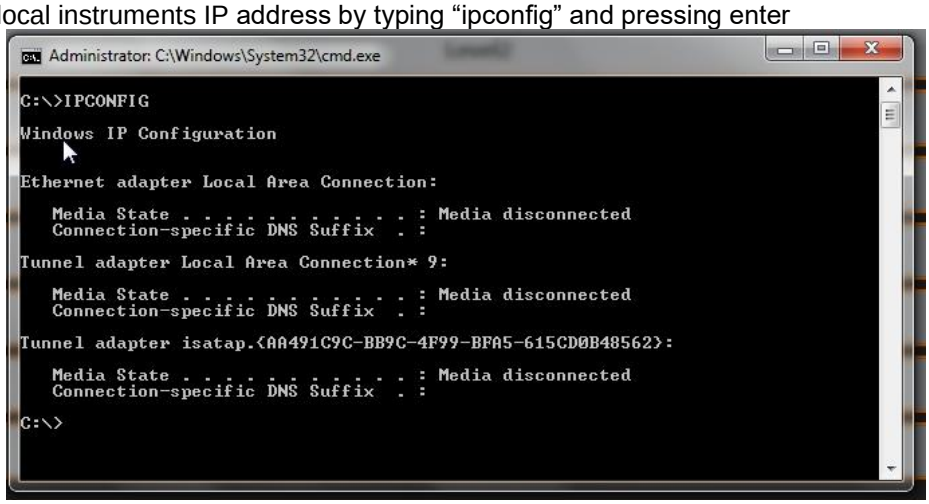


Figure 65: Operating system ipconfig

Check connection to other instruments using the “PING” feature. Type “Ping 127.0.0.1” to ping the IP address to the system you would like to check communication with:

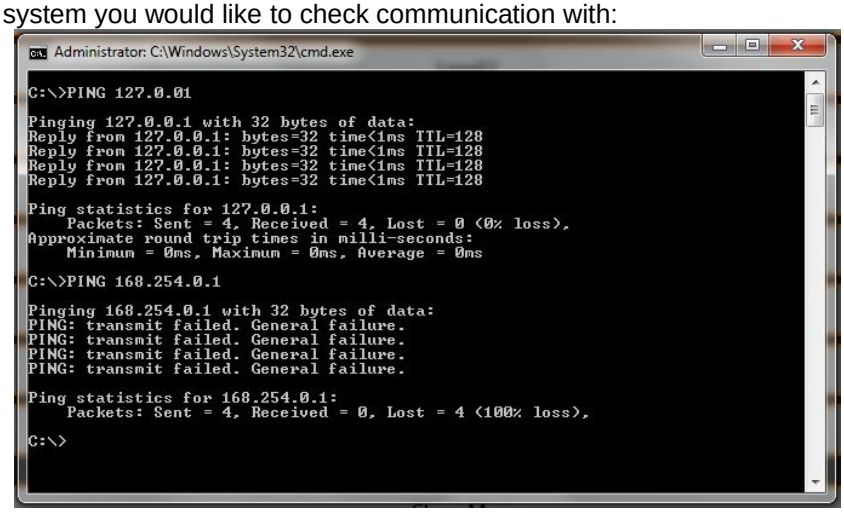


Figure 66: Operating system ping

Access file explorer by typing “explorer”

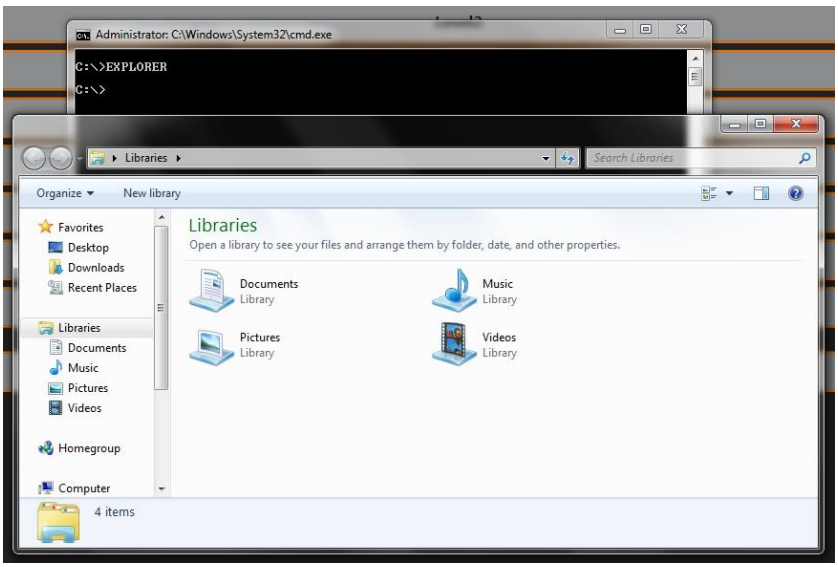


Figure 67: Operating system file explorer

7.2.1 Upgrading Software from ≤V3 to ≥V6.4 or V5.23 to ≥V6.4

Gain access to the file explorer as explained in section 7.2 and locate the “Instrument” folder and within the file list, locate and start the installer “Heraeus.iM2.WirelessCastemp.DeployAgent.exe”. Follow the on screen instructions.

Before carrying out a software upgrade or significant change:

For instruments of s/n < 180200: Check the free disk space in Windows Explorer. If <750 MB, refer to HEN for further advice.

Save settings (either via download or photographically). For V6.x or later, use the “save settings” feature to save to external storage or desktop (section 7.1). Key settings to record are:

- Settings
- LAN1 and 2
- Physical Devices
- Telegrams
- Bindings

Note: Instrument recovery
After update, save the settings again, to desktop or USB drive. It can be good practice to keep a USB drive inside the instrument case containing the latest software version, *.cws settings file and *.lic licence file in case of instrument recovery. The licence file will only activate the instrument for which it has been raised.

Note: Upgrade from V5.xx to ≥V6.4 running Superheat. Due to the different way the licence is managed between these two versions; on initial boot up, the current licence will be lost.
Prior to Upgrade: Locate the *superheat.lic* retained in the C:\Castemp directory and save to another location or obtain the original or a new licence file. Upgrade the software, and update as per section 7.6. For version ≥6.2, the licence is retained in the database. It is recommended to store the original **.lic* licence file in a known location, such as a USB drive as noted above.
Upgrade Remote Viewer
Confirm all Remote Viewer applications (HMI or PC based) and upgrade to the same software version. See Appendix 3: Remote Client Installation and set up

7.3 Date and Time

This allows the time zone and the date and time of the CasTemp Wireless instrument to be set to the local environment by direct access to the control panel settings.

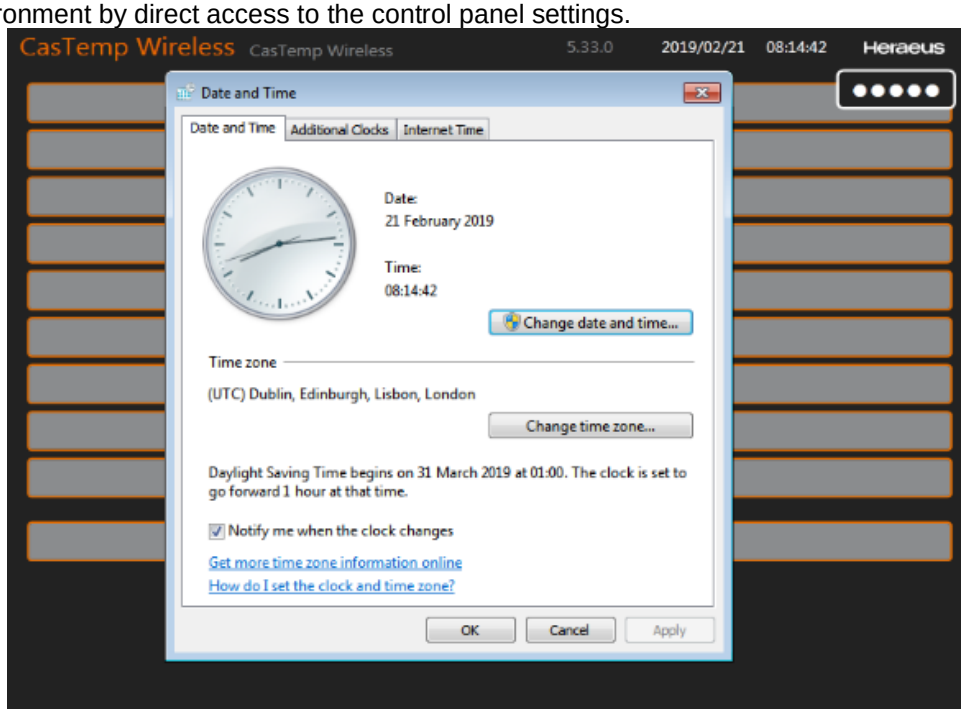


Figure 68: date and time seting

7.4 Firmware Upgrade

The firmware of the QUBE CTW module can be upgraded through the CasTemp Wireless instrument software using the following procedure:

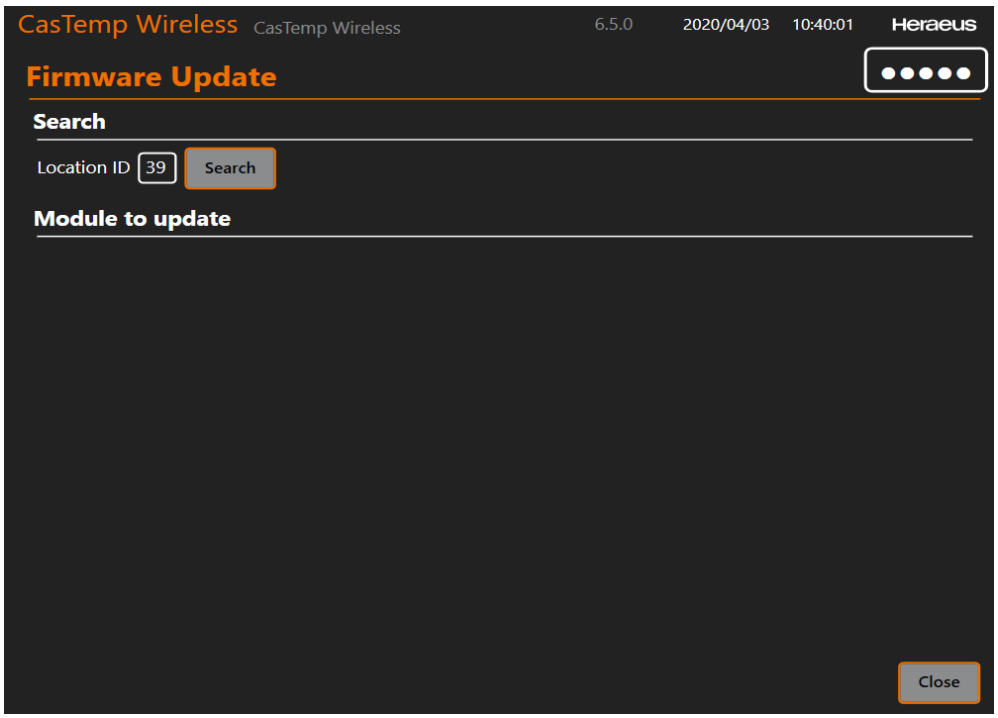


Figure 69: Firmware Update

1. Set the QUBE CTW module to “Ready to Pair” (green flashing LED) by using the CASTEMP SHORTING TOOL to initiate continuity and pressing the button. See section
2. Set the instrument location ID to 41: QUBE CTW module pairs on location ID 41.
3. Click on Search and the QUBE CTW module number will appear when found.

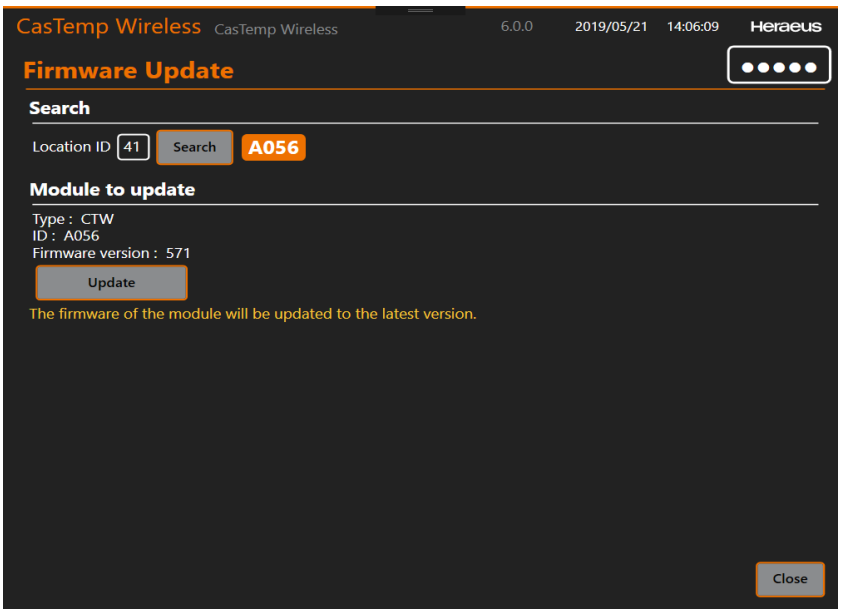


Figure 70: Firmware update module id confirmed

4. Click on QUBE CTW module number.
5. Click on Update:
    a. On the QUBE CTW module both lights will flash for several minutes during update, however the software might indicate completion before this. DO NOT close this screen until the module completes
    b. **IMPORTANT:** The operation is only complete when the two amber LED's on the QUBE CTW module stop flashing, and the module reverts to a green "ready to pair" LED
    c. **IMPORTANT:** The update process locks the instrument onto location ID 41 for a few minutes, preventing the pairing of other instruments. It is recommended that firmware upgrade is carried out offline in a workshop environment.
6. Repeat steps 2 and 3 to confirm firmware is correct.
7. Close the menus and test that the QUBE CTW module correctly pairs (Section 4.2).

Recovery of a module

In the event of a failure to complete the update, the module may be recovered as follows:

a. Set the location ID to 0 and click on Search
b. Immediately start the module, it should be found quickly
c. Repeat steps 3-6.

If this does not work, return the module for repair.

Note: On start-up, the module may be briefly located on location ID 0, regardless of whether functional firmware is installed.

7.5 Download Data

Click the Download Data button to access the Download Data screen. The screen of Figure 71 pops up.

Figure 71: Download Data window

Choose between CasTemp and CasTip to download the relevant information. Set a directory destination to export measurement values to. This can be on the hard drive or a removal drive. Use the Browse button to set the path correctly. Then:

- Select the stored values for a pairing sequence individually, by use of the check boxes. Each line selected will be highlighted. They can be unselected by removing the check.
- Select 'Export measurements': this will report start / stop values
- Select 'Export samples': this will report the values measured

The exported data is in the form of a CSV file which can read imported into a suitable program or spreadsheet for interrogation.

7.6 License

Click the License button to access the License screen. The screen of Figure 72 pops up.
The CasTemp Superheat option will be locked behind a license. The procedure to obtain the license code is given in section 9.6 and the approval form is shown in

Appendix 5: CasTemp approval form.

Figure 72: License screen

7.7 Close Program

Close Program is not required in normal instrument use. Contact your HEN representative if required.

8 Technical Data

8.1 Operating Specification

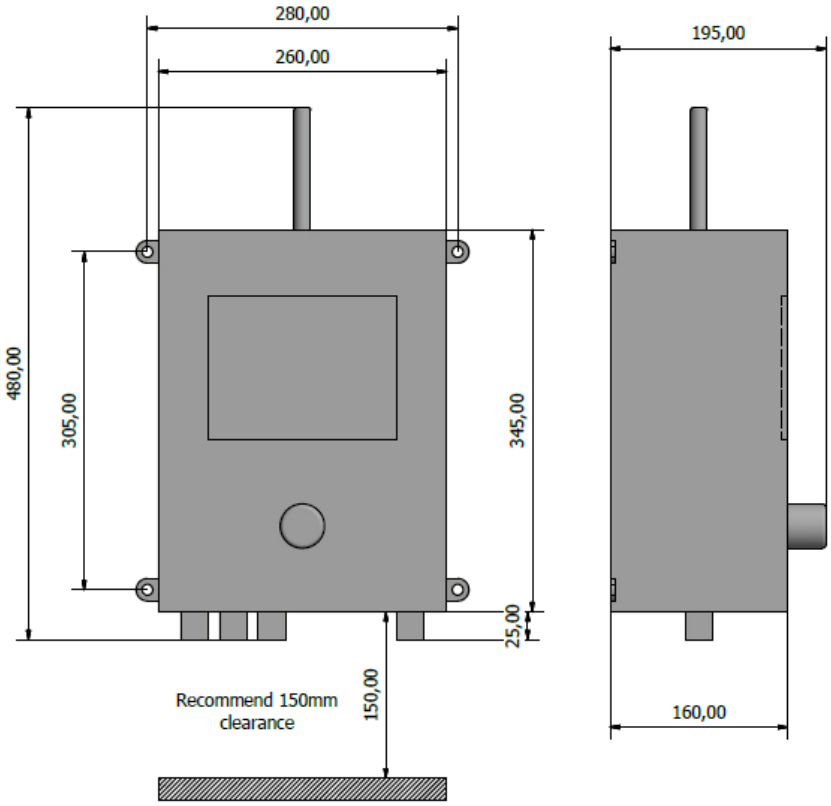
QUBE CTW module		
	Minimum Temperature	**Maximum Temperature**
Specified Operating Temperature Range	**-20^{0}C**	**60^{0}C**
Do not exceed Temperature Range	**-30^{0}C**	**85^{0}C**
Battery Charging	**0^{0}C**	**60^{0}C**
The sensor contact block has a maximum operating temperature of 200^{0}C		
The wireless transmission system will not operate at temperatures above 85^{0}C		
The Qube CTW module must NOT be exposed to temperatures above 85^{0}C to avoid risk of permanent damage to electronics and batteries		
Battery	***LiFePO$_4$ 3.2V 3Ah***	
Charging	***5V dc 850mA via USB socket***	
Wireless module	***2.4 GHz (2.4-2.483 GHz) frequency hopping***	

8.2 Measurement Specification

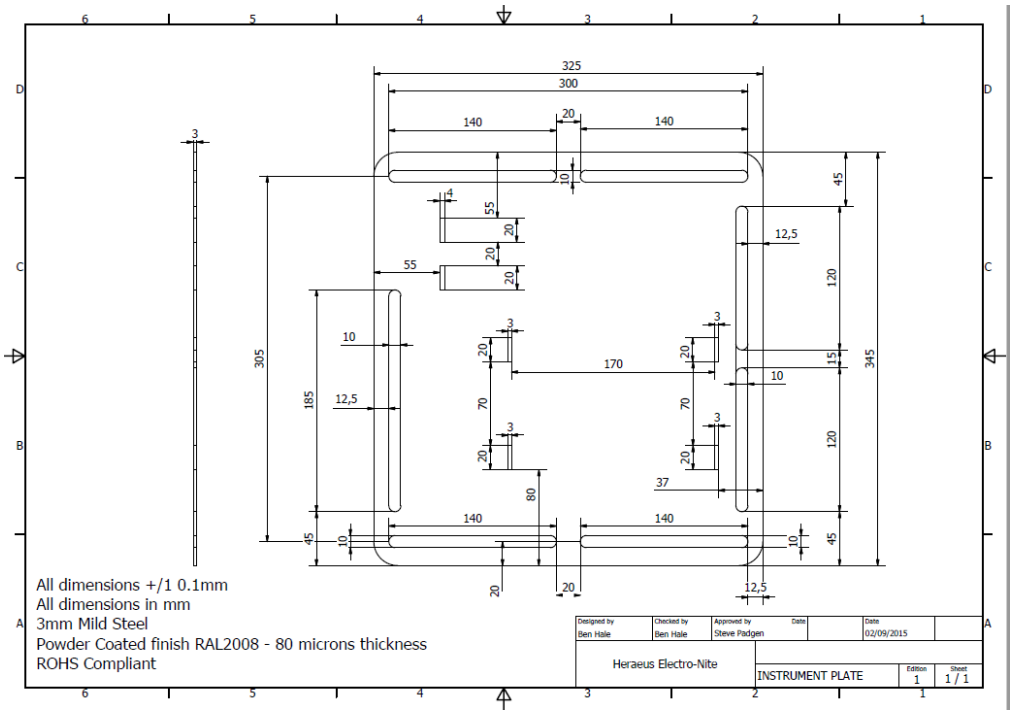
Measurement application	Continuous temperature measurement in tundishes	
Measurement input	Thermocouple type B	CasTemp sensor using QUBE CTW module
Temperature input range	0°C to 1810°C	
Measurement accuracy	Temperature +- 1°C	For ambient temperature between 0 and 50°C
Data output	TCP, RS232, Profibus, EIP	
Housing, dimensions and weight	Metal housing protection IP65	
Operating data	Power supply 110V/220V	50/60 Hz

8.3 Instrument drawings

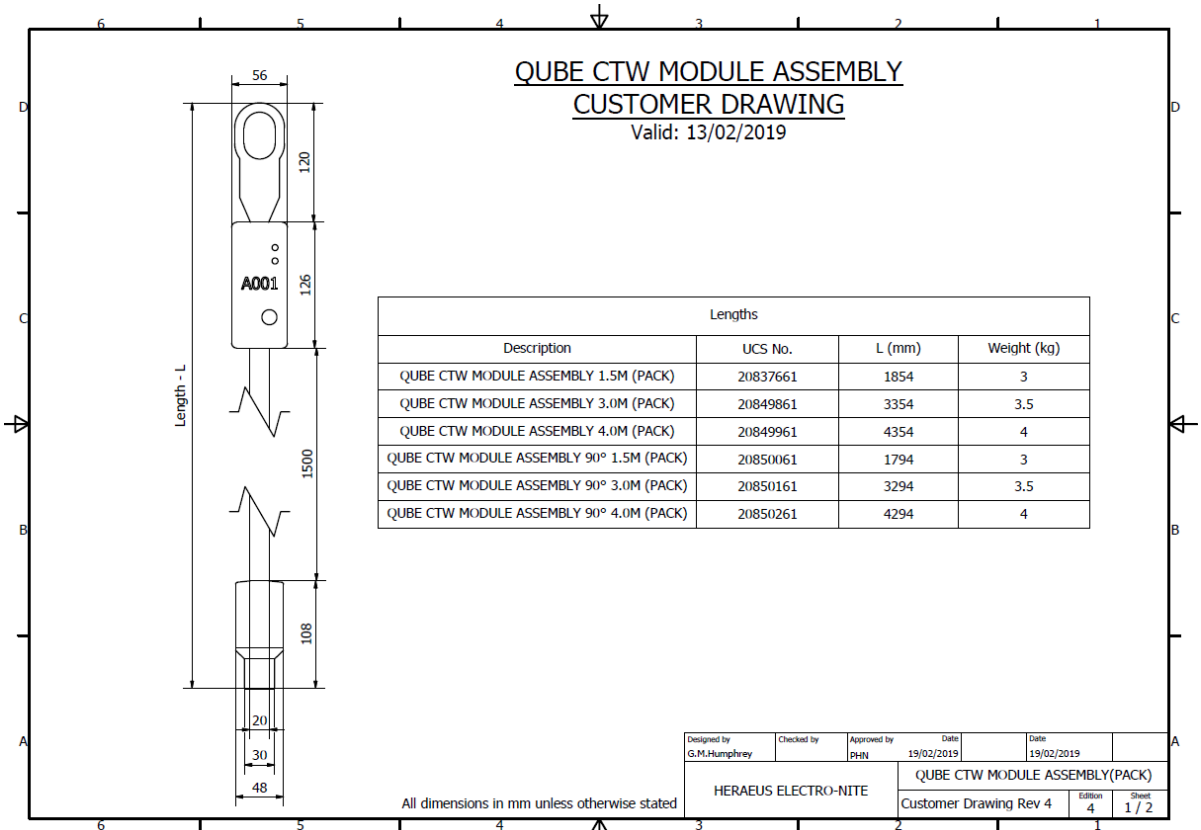
8.3.1 Instrument



8.3.2 Mounting Plate

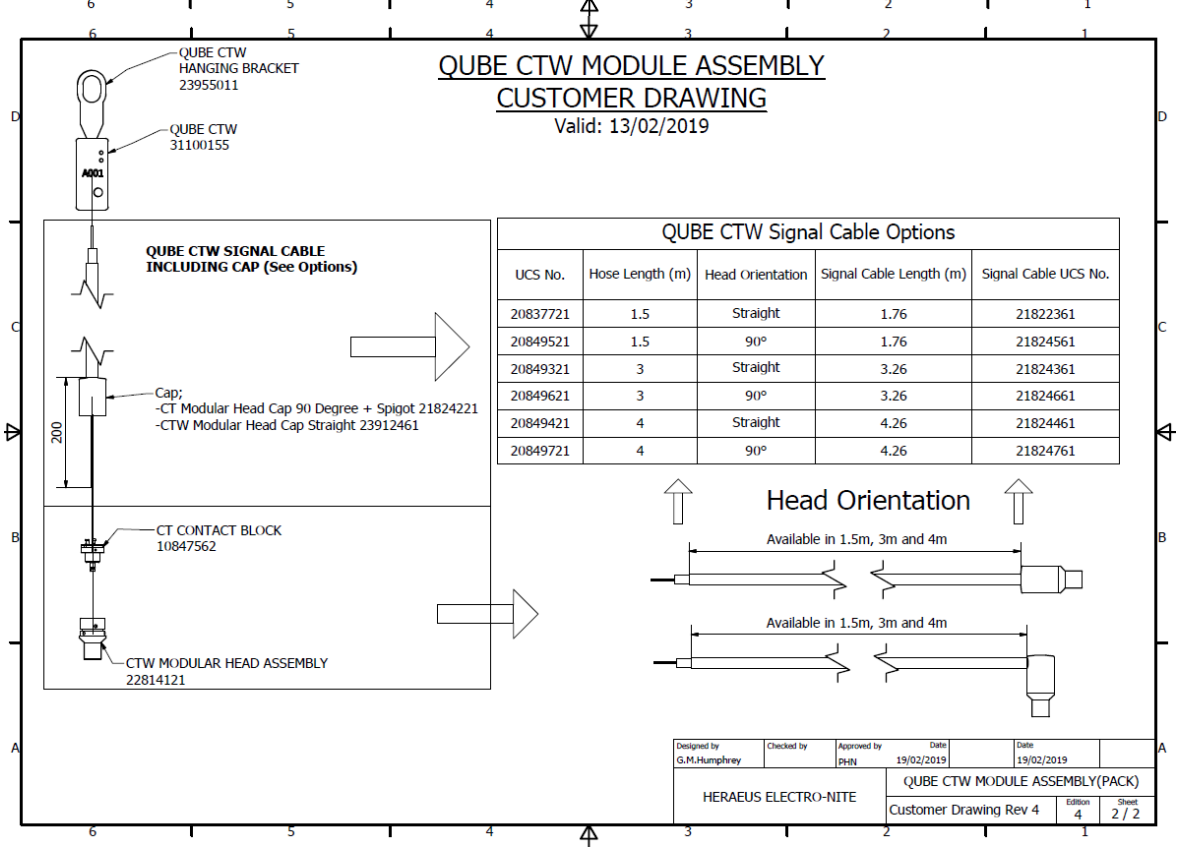


8.3.3 QUBE CTW Module – model 1



Lengths

Description	UCS No.	L (mm)	Weight (kg)
QUBE CTW MODULE ASSEMBLY 1.5M (PACK)	20837661	1854	3
QUBE CTW MODULE ASSEMBLY 3.0M (PACK)	20849861	3354	3.5
QUBE CTW MODULE ASSEMBLY 4.0M (PACK)	20849961	4354	4
QUBE CTW MODULE ASSEMBLY 90° 1.5M (PACK)	20850061	1794	3
QUBE CTW MODULE ASSEMBLY 90° 3.0M (PACK)	20850161	3294	3.5
QUBE CTW MODULE ASSEMBLY 90° 4.0M (PACK)	20850261	4294	4



QUBE CTW Signal Cable Options

UCS No.	Hose Length (m)	Head Orientation	Signal Cable Length (m)	Signal Cable UCS No.
20837721	1.5	Straight	1.76	21822361
20849521	1.5	90°	1.76	21824561
20849321	3	Straight	3.26	21824361
20849621	3	90°	3.26	21824661
20849421	4	Straight	4.26	21824461
20849721	4	90°	4.26	21824761

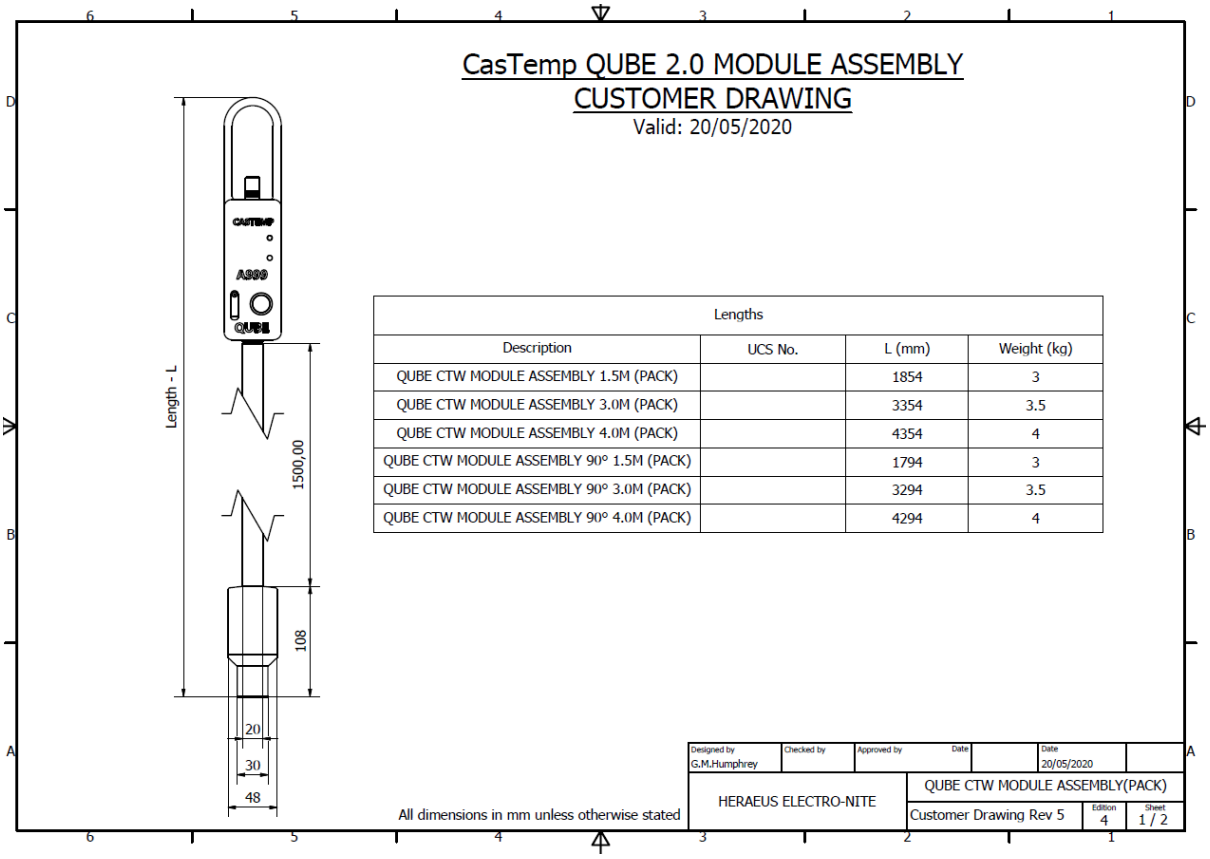
8.3.4 QUBE CTW Module – model 2 - CasTemp Qube module

An update to the QUBE CTW module has been made for design improvements and to replace obsolete parts from assemblies.

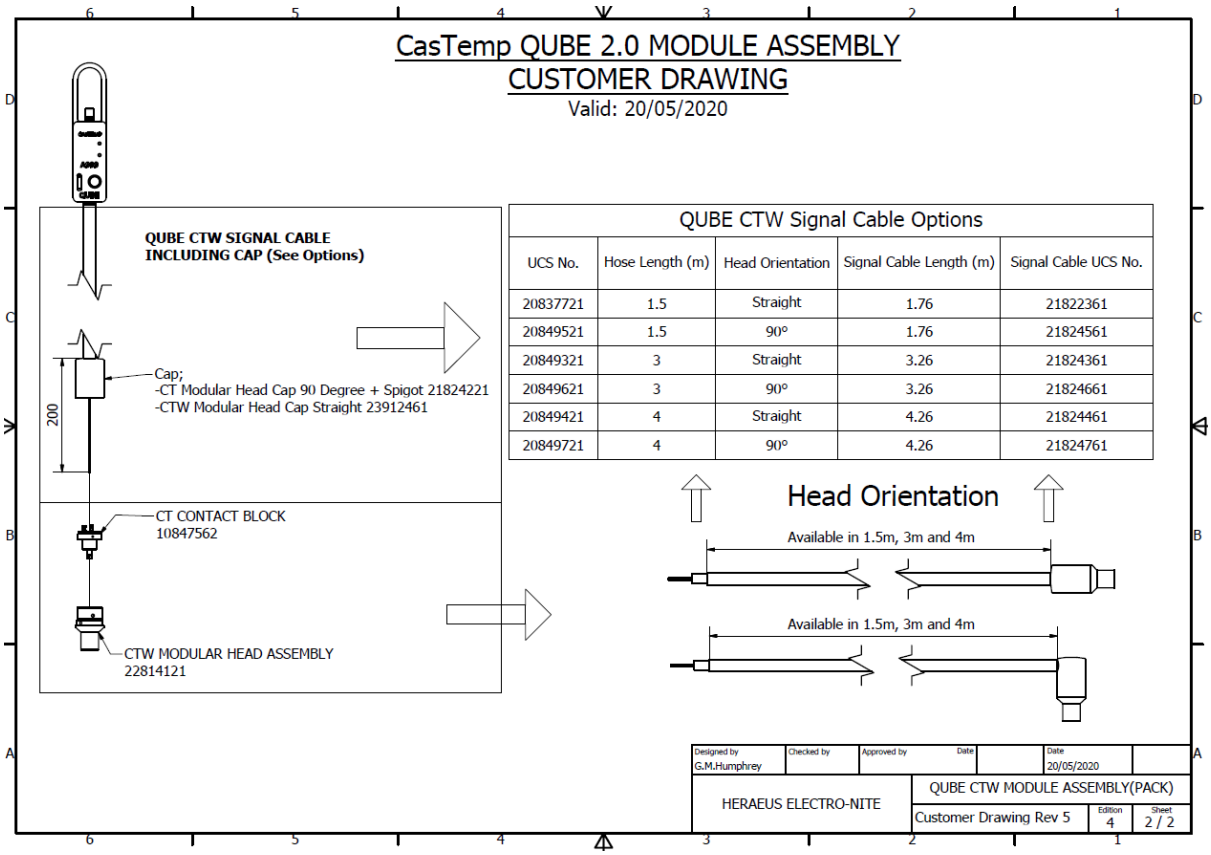
Changes include:

- Antenna
- Case Design
- Sealing
- Hanging Hook/Hoop
- Spigot
- Signal Cable Gland
- Graphics Front and Rear
- Vent Pad on Rear
- USB-C Charging
- Packaging
- Description change to 31100155 from Qube CTW to CasTemp Qube
- CTW Charging Cable USB-C

Model 2 CTW Qubes are most easily identifiable by the black anodised hoop which replaces the silver hook of the model 1 and also the text “CasTemp” on the front which replaces the text “CTW” of the model 1. Ensure when ordering spares that the spares for the correct model are ordered as some parts differ between models.



Lengths			
Description	UCS No.	L (mm)	Weight (kg)
QUBE CTW MODULE ASSEMBLY 1.5M (PACK)		1854	3
QUBE CTW MODULE ASSEMBLY 3.0M (PACK)		3354	3.5
QUBE CTW MODULE ASSEMBLY 4.0M (PACK)		4354	4
QUBE CTW MODULE ASSEMBLY 90° 1.5M (PACK)		1794	3
QUBE CTW MODULE ASSEMBLY 90° 3.0M (PACK)		3294	3.5
QUBE CTW MODULE ASSEMBLY 90° 4.0M (PACK)		4294	4



QUBE CTW Signal Cable Options

UCS No.	Hose Length (m)	Head Orientation	Signal Cable Length (m)	Signal Cable UCS No.
20837721	1.5	Straight	1.76	21822361
20849521	1.5	90°	1.76	21824561
20849321	3	Straight	3.26	21824361
20849621	3	90°	3.26	21824661
20849421	4	Straight	4.26	21824461
20849721	4	90°	4.26	21824761

8.4 CasTemp Wireless Instrument Specifications

CTW Instrument Power Specification

Voltage: 90-264VAC/ 47-63Hz Power: 34VA

CTW Instrument Temperature Specification

Max: 50°C Min: 0°C

CTW Instrument Humidity Specification

Max: 90% Min: 0%

QUBE CTW Module battery specification:

Voltage: 3.2v Amp Hour: 3Ah Watt Hour: 9.6Wh Chemistry: LiFePO4

8.5 QUBE CTW Module – repair

See Section 10.6 Appendix 6: QUBE CTW Module Repair Guide

9 CasTemp Superheat

9.1 CasTemp Superheat Introduction

Heraeus Electro-Nite (HEN) has developed a CasTemp Superheat package as a means for enhancing the visualization of dynamic Superheat during casting, and ultimately helping to improve the process control of casting through optimal use of the features included in the package. In addition to the CasTemp continuous temperature measurement, the CasTip direct reading liquidus sensor will measure the Liquidus in the tundish. The system includes integration of the CasTip direct reading liquidus sensor to measure tundish liquidus and hence offer a current superheat and a forward prediction towards end of cast. Software version >6.4 or greater will allow both measurements to be displayed on the CasTemp Wireless instrument screen as part of the CasTemp Wireless instrument system. Also the system can predict when the superheat will go lower than a customer's defined critical limit. The system is available through software upgrade and integration of inputted plant data. All CasTemp Wireless instrument models are capable of the software upgrade to CasTemp Superheat functionality. QUBE CTW modules need to be on firmware version 571 or greater.

9.2 Screen differences

9.2.1 CasTemp Wireless Instrument Measurement Screen in standard mode

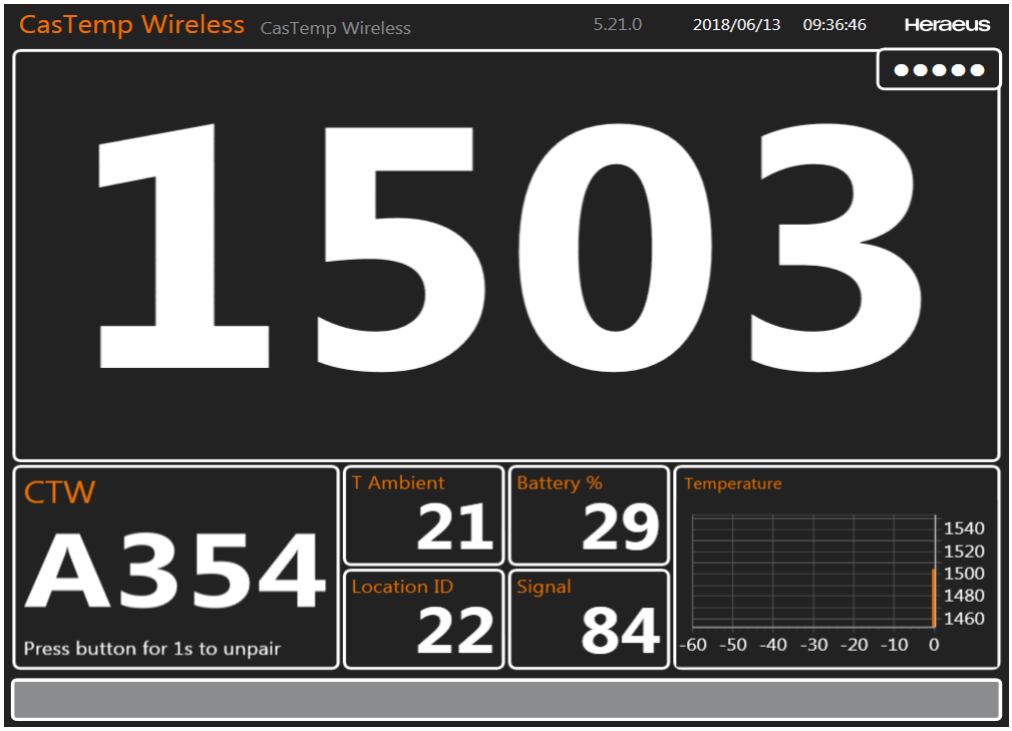


Figure 73: Standard CasTemp wireless Instrument Screen

9.2.2 CasTemp Wireless Instrument Measurement Screen in CasTemp Superheat mode

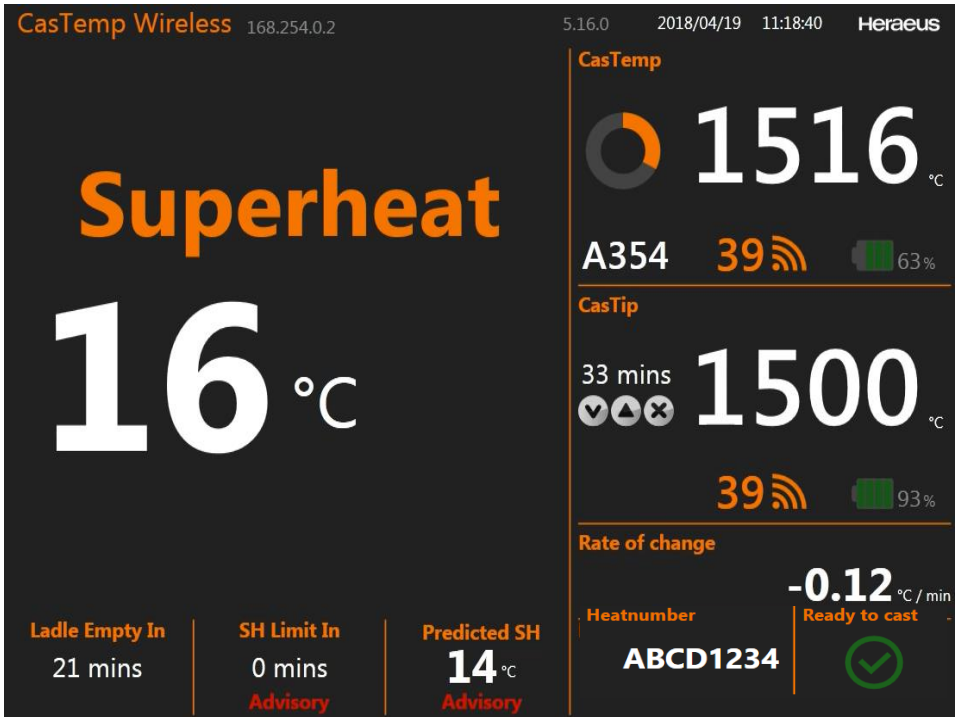


Figure 74: SuperHeat Mode

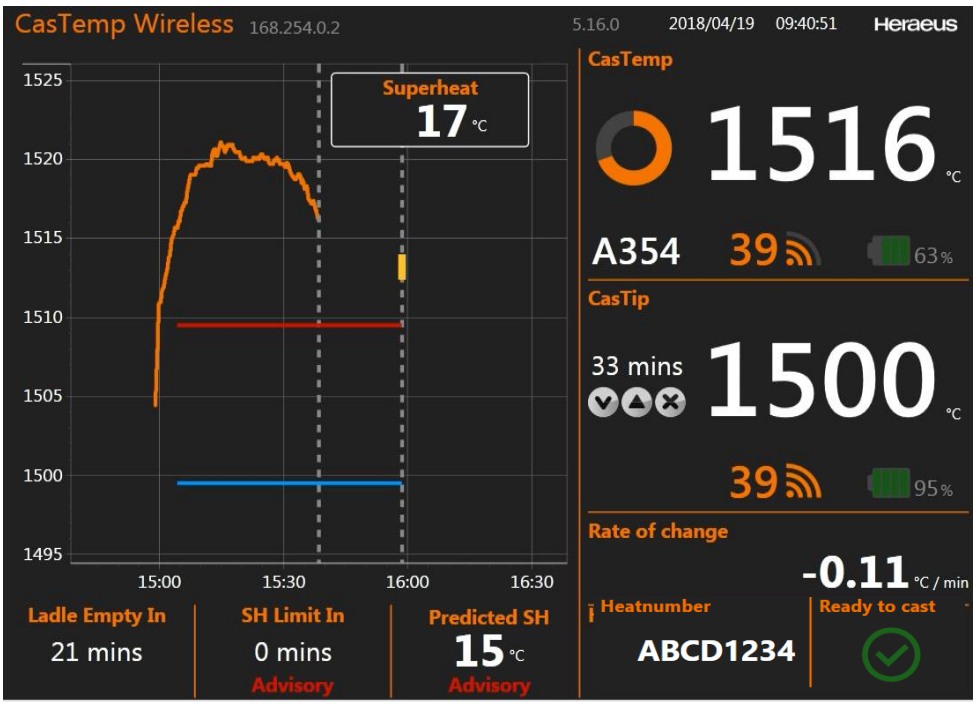


Figure 75: SuperHeat Prediction Mode

- Large or small graphs: (see section 5.1.3 Graph settings)
  - In standard mode this positions the graph on the main screen or bottom right corner
  - **In superheat mode** then either the superheat is displayed (small) or the prediction screen is displayed (large)

9.3 Hardware Requirements

CasTemp Superheat is based upon CasTemp Wireless so all the components required for the standard CasTemp Wireless instrument set up are still required along with these additions:

Table of required equipment for CasTip set up:

Item	Component	UCS	SAP Description	Long Description
1	CasTip QUBE Box	31010001	QUBE KIT CASTIP	includes x1 QUBE CASTIP, X2 POWERPACK BATTERY WIRELESS And CHARGING STATION-WIRELESS
2	CasTip QUBE	31090020	QUBE CASTIP	includes x1 POWERPACK BATTERY WIRELESS
3	Battery (Power Pack)	39970004	POWERPACK BATTERY WIRELESS	
4	Power Pack Charger	39980258	CHARGING STATION-WIRELESS	Includes 4 plugs
5	Lance / Pole Handle	39800017	HANDLE W/CVR W/CONN FEM 4P NON-COMP	
6	CasTip Probe / Sensor Holder	20850960	CASTIP LANCE HOLDER + CTB + CABLE P1	(including 4m 2 core Cu-Cu signal cable) - NOTCHED
7	CasTip Sensor -packed in box of 12 pieces	10570661	CAST36000900 P360	UCS number is the complete pallet of 30 boxes (360 pieces) and smaller quantities.

A CasTip Lance will need to be prepared in order to take a CasTip measurement. A CasTip Lance Assembly Guide Assembly Guide is shown in Appendix 7: QUBE CasTip Lance Build Guide and is supplied with each CasTip Lance Holder.

9.3.1 CasTip QUBE

The CasTip QUBE connects to a manual dipping lance handle and transfers signal wirelessly to the CTW instrument. This QUBE needs to be set to the location ID defined in the instrument.

- CasTip QUBE
- Battery Charger
- 2 x batteries
- User guide

9.3.2 Sensor / Probe Holder and Signal Cable (CASTIP LANCE HOLDER)

The probe holder comes ready made with a contact block and a 4m extension cable. This is non-compensated cable as no part of the lance is expected to exceed 50°C. The 4m cable can be cut to fix the length of the lance required. Please note 4m is the maximum standard length supplied.

9.3.3 Lance Handle

The lance handle connects to the lance/pole via a ¾ thread, the QUBE CASTIP then is attached to the lance handle. The contact block inside the handle must be wired to the **oxygen** channel.

	Attach the copper wire to the lance handle insert. **GREY CABLE (+) to O+** **WHITE CABLE (-) to O-**

The immersion system must be checked to ensure that the signal lights are clearly visible to the operator as the measurement involves waiting until the sample if fully frozen and a liquidus arrest is verified through the software.

9.3.4 CasTip Sensor

CasTip is the sensor which obtains the liquidus measurement. How this sensor is used is shown in Section 9.8.3 Immersion Procedure and Signalisation

9.4 Level 2 communication

CasTemp Superheat sends information to the plant but also requires information from the plant for the functionality.
The following will be covered:

- Communication Protocols for output to plant
- Communication Protocols for input to CasTemp Superheat
- Telegram requirements
- Timings

9.4.1 Communication Protocols for output to plant

The following communication protocols can be used to send data from the CasTemp Wireless instrument to the plant:

- Serial
- TCP IP (Server and Client)
- Profibus
- Ethernet IP

9.4.2 Communication Protocols for input to CasTemp Superheat

The following communication protocols can be used to receive data from the plant:

- TCP IP (Server and Client)
- Profibus
- Ethernet IP

Check the box ‘Use for inputs’ to enable this functionality in section 6.2.
Serial is the only communication that does NOT accept input from the plant.

9.4.3 Telegram Requirements

There are 5 telegrams that the CasTemp Superheat requires from the plant, these telegrams will be explained and their format will be shown:

Telegram Name	Definition and Purpose
Heat Number	Identity assigned to the steel being cast through the tundish, normally upon ladle opening and normally ignoring any time lag between the ladle shroud and tundish outlet. Used to reset the liquidus value.
Time Synchronisation	Plant time or PLC time reference, however the plant want to define this reference, to enable time synchronization between the CasTemp Superheat system and plant
Ladle Empty Time	A static or preferably dynamic time estimate of when the ladle will empty, which is used as the last superheat prediction point.
Critical Superheat Limit	Plant defined limiting superheat above current liquidus. Upon Superheat reaching this value, plants would expect the caster operator to be taking appropriate action.
Ready to Cast	A digital signal which is ***either*** tundish in casting position ***or*** tundish in casting position **and** CasTemp connected and operational. Tundish not in position **and** CasTemp connected represents preheat “Ready to Cast” is used to define which instrument is in live casting and therefore where CasTip liquidus information sent to both will be used

9.4.3.1 Data formats

The following data types are defined. All formats are big endian (high byte first).

<table>
<tr><th>Format</th><th>Description</th><th>Size</th></tr>
<tr><td>StringFormat-N</td><td>Text string. Every byte is a character
N = the number of characters that is used by the ASCII string. In case the value is smaller than the size, append the string with sufficient NULL-bytes</td><td>1 byte per character</td></tr>
<tr><td>WholeNumberString-N</td><td>Whole number string
0-9999 (ASCII string)
N = the number of characters that is used by the ASCII string.</td><td>4 bytes</td></tr>
<tr><td>DynamicStringFormat</td><td>ASCII-encoded dynamic size string. This data type is a combination of a ushort specifying the size and a StringFormat-{size}</td><td>1 byte per character</td></tr>
<tr><td>Byte</td><td>The value is transferred as a byte</td><td>1 byte</td></tr>
<tr><td>UShort</td><td>The value is transferred as a ushort</td><td>2 bytes</td></tr>
<tr><td>Int32</td><td>The value is transferred as a integer</td><td>4 bytes</td></tr>
<tr><td>Single precision float</td><td>The value is transferred in Single-precision floating-point format.</td><td>4 bytes</td></tr>
<tr><td>Double precision float</td><td>The value is transferred in Double-precision floating-point format.</td><td>8 bytes</td></tr>
<tr><td>DateTimeFormat</td><td>An array of 7 bytes that represents the date and time.
<table>
<tr><th>Byte</th><th>Value</th><th>Example</th></tr>
<tr><td>1</td><td>Day</td><td>23</td></tr>
<tr><td>2</td><td>Month</td><td>5</td></tr>
<tr><td>3</td><td>Year1</td><td>20</td></tr>
<tr><td>4</td><td>Year2</td><td>18</td></tr>
<tr><td>5</td><td>Hour</td><td>12</td></tr>
<tr><td>6</td><td>Minute</td><td>17</td></tr>
<tr><td>7</td><td>Second</td><td>53</td></tr>
</table>
Example:
23/05/2018 12:17:53</td><td>7 bytes</td></tr>
<tr><td>TempUnit</td><td>ASCII format => C = Celsius, F = Fahrenheit</td><td>1 byte</td></tr>
<tr><td>DateTimeFormatAscii</td><td>yyyyMMddHH:mm:ss
Example: September 11, 2019 9:53:15 ⇨ 2019091109:53:15</td><td>16 bytes</td></tr>
<tr><td>Char</td><td>ASCII char</td><td>1 byte</td></tr>
</table>

9.4.3.2 Heat Number

Heat number is the unique identification of the ladle of steel been currently cast. This is expected change every time a new ladle is received by the caster.

9.4.3.2.1 Byte

Field name	Description	Data format
Message header		
Id	1	Byte
DataCount	8	UShort
Payload		
Heat number	The heat number	StringFormat-8

Example
Heat number = ABCD1234

Field	Id	DataCount	Heat number
Hex value	{01}	{00}{08}	{41}{42}{43}{44}{31}{32}{33}{34}
Byte index	1	[2-3]	[4-11]

9.4.3.2.2 ASCII

Field name	Description	Data format
Message header		
Id	1	1 Char
DataCount	8	2 Chars
Payload		
Heat number	The heat number	8 Chars

Example

Heat number = ABCD1234

Field	Id	DataCount	Heat number
Char value	1	08	ABCD1234
Byte index	1	[2-3]	[4-11]

9.4.3.3 Time Synchronisation

CasTemp SuperHeat can accept a time input from the PLC which will match the time shown on screen to the time that all the other plant equipment is calibrated to.

9.4.3.3.1 Byte

Field name	description	Data format
Message header		
Id	2	Byte
DataCount	7	UShort
Payload		
DateTime	The new datetime for the instrument	DateTimeFormat

Example

DateTime = 23/04/2019 15:09:54

Field	Id	DataCount	DateTime
Hex value	{02}	{00}{07}	{17}{04}{14}{13}{0F}{09}{36}
Byte index	1	[2-3]	[4-10]

9.4.3.3.2 ASCII

Field name	description	Data format
Message header		
Id	2	1 Char
DataCount	7	2 Chars
Payload		
DateTime	The new datetime for the instrument	DateTimeFormatASCII

Example

DateTime = 23/04/2019 15:09:54

Field	Id	DataCount	DateTime
Char value	2	16	2019042315:09:54
Byte index	1	[2-3]	[4-19]

9.4.3.4 Ladle Empty Time

Ladle Empty time is the dynamic time when the caster expects to be finished with the ladle. This is in minutes format. Example (30) minutes until ladle empty

9.4.3.4.1 Byte

Field name	description	Data format
Message header		
Id	3	Byte
DataCount	4	UShort
Payload		
Remaining minutes until ladle empty	The number of minutes until the ladle is empty.	Int32

Example

Remaining minutes until ladle empty = 75

Field	Id	DataCount	Remaining minutes until ladle empty
Hex value	{03}	{00}{04}	{00}{00}{00}{4B}
Byte index	1	[2-3]	[4-7]

9.4.3.4.2 ASCII

Field name	description	Data format
Message header		
Id	3	1 Char
DataCount	4	2 Chars
Payload		
Remaining minutes until ladle empty	The number of minutes until the ladle is empty.	4 Chars

Example

Remaining minutes until ladle empty = 75

Field	Id	DataCount	Remaining minutes until ladle empty
Char value	3	04	0075
Byte index	1	[2-3]	[4-7]

9.4.3.5 Critical SuperHeat Limit

Critical Superheat Limit is the amount of Superheat the customer would like to display graphically above the measured liquidus. I.e. if the customer wanted 10°C Superheat limit and CasTip measured liquidus at 1500°C the software would graphically display 1510°C as the Superheat limit.

9.4.3.5.1 Byte

Field name	description	Data format
Message header		
Id	4	Byte
DataCount	5	UShort
Payload		
SH value	The limit at which the customer wants to be warned. This is not an absolute value, but an offset added to the current LT temperature	Int32
Temperature unit	Represents the temperature unit of the SH value.	TempUnit

Example

SH value = 15

Temperature unit = Celsius

Field	Id	DataCount	SH value	Temperature Unit
Hex value	{04}	{00}{05}	{00}{00}{00}{0F}	{43}
Byte index	1	[2-3]	[4-7]	8

9.4.3.5.2 ASCII

Field name	description	Data format
Message header		
Id	4	1 Char
DataCount	5	2 Chars
Payload		
SH value	The limit at which the customer wants to be warned. This is not an absolute value, but an offset added to the current LT temperature	4 Chars
Temperature unit	Represents the temperature unit of the SH value.	TempUnit

Example
SH value = 15
Temperature unit = Celsius

Field	Id	DataCount	SH value	Temperature Unit
Char value	4	05	0015	C
Byte index	1	[2-3]	[4-7]	8

9.4.3.6 Ready to Cast

Ready to Cast is a telegram which tells the software that the tundish is in casting position. This allows a CasTip measurement to be taken and displayed on screen.

9.4.3.6.1 Byte

Field name	description	Data format
Message header		
Id	5	Byte
DataCount	1	UShort
Payload		
Status	Indicates if the plant is ready to cast	Byte 1: Ready 2: Not ready

Example
Status = Not Ready

Field	Id	DataCount	Status
Hex value	{05}	{00}{01}	{02}
Byte index	1	[2-3]	4

9.4.3.6.2 ASCII

Field name	description	Data format
Message header		
Id	5	1 Char
DataCount	1	2 Chars
Payload		
Status	Indicates if the plant is ready to cast	1 Char 1: Ready 2: Not ready

Example
Status = Not Ready

Field	Id	DataCount	Status
Char value	5	01	2
Byte index	1	[2-3]	4

9.4.4 Telegram Timings

The following is a flow chart of an example timing for receiving of information from the plant:

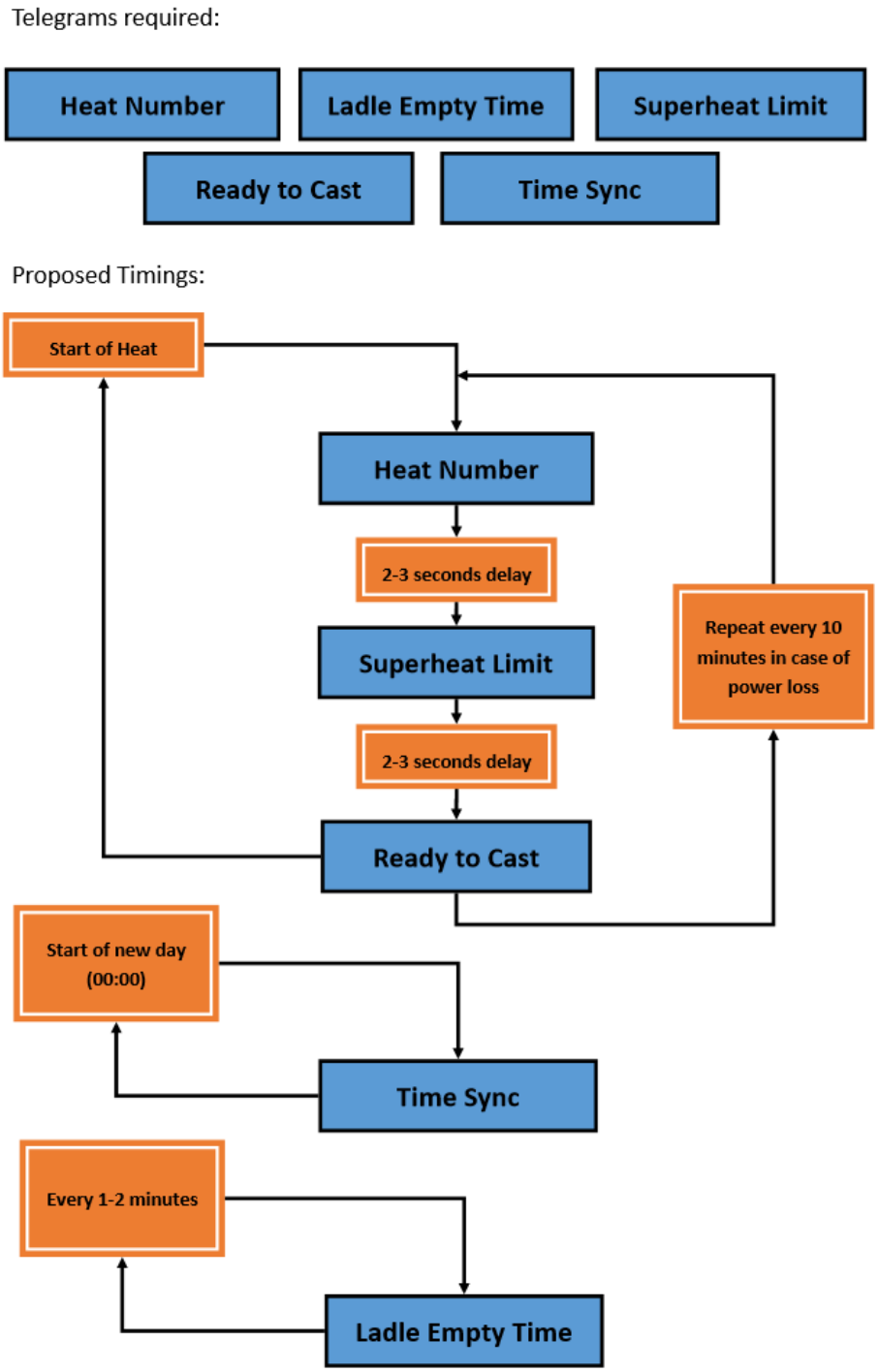


Figure 76: Telegram timings for Superheat mode, Flow Sheet

9.4.5 Telegram Output

The following table shows the output of a telegram in the 4 possible conditons: paired; non-paired; loss of transmission or open cicuit.

Telegram Input	Paired		Not - Paired		Loss of Transmission		Open Circuit	
	Character Length	Output Value	Character Length	Output Value	Character Length	Output Value	Character Length	Output Value
Superheat	6	0009.9	6	UUUU.U	6	LLLL.L	6	FFFF.F
Liquidus	6	1500.1	6	UUUU.U	6	LLLL.L	6	FFFF.F
Time of Liquidus	19	13/02/2018 11:45:24	19	CLEAR	19	CLEAR	19	CLEAR
Battery Charge QUBE	4	098%	4	UUUU	4	LLLL	4	FFFF
Heat Number	8	ABCD1234	8	UUUUUUUU	8	LLLLLLLL	8	FFFFFFFF
Prediction	6	------	6	UUUUU.U	6	CLEAR	6	CLEAR
Ladle Empty	6	--------	6	CLEAR	6	CLEAR	6	CLEAR
SH Limit Time	19	----------	19	CLEAR	19	CLEAR	19	CLEAR
Rate of Change	6	002.34	6	UUU.UU	6	LLLL.L	6	FFFF.F

9.5 Profibus and Ethernet IP set up

9.5.1 Profibus Set up

Profibus uses a M30 Anybus module which a maximum byte capacity of 128 bytes. All 128 bytes can be allocated to output when operating in CasTemp Wireless Instrument Measurement standard mode, however when in CasTemp Superheat mode some of this allocation needs to be set to input. This allocation is recommended to be split in half with 64 bytes output and 64 bytes input. However this is flexible, the GSD offers flexibility to allow any number of bytes to be set on both in input and output side of the card, again up to a 128 byte limit. GSD file can be found via HEN contact.

9.5.2 Ethernet IP Set up

Ethernet IP uses a M40 Anybus module which a maximum byte capacity of 256 bytes. All 256 bytes can be allocated to output when operating in CasTemp Wireless Instrument Measurement standard mode, however when in CasTemp Superheat mode some of this allocation needs to be set to input. The input/output EDS defines, 128 bytes output, 128 bytes input. The ESD file can be found via HEN contact.

9.6 License

The following procedure must be followed to obtain the license code.

1. Ensure software version 6.0 or greater is installed
2. Sign the CasTemp Approval Form found in

3. Appendix 5: CasTemp approval form
4. Gain access to “24816” menu when unpaired and select license.
5. Change the serial number to that of the instrument (found on the bottom of the instrument i.e. 150100)
6. The hardware ID will be shown on screen. Click “Copy to file” to store this hardware ID in a text file. A window will appear – rename the file to match the serial number of the instrument and save to memory stick.
7. Next email this txt file and CasTemp approval form to the License authoriser, they will send back a .lic file with the same file name
8. In the license menu click “update” and locate this file and press ok. The screen of figure 77 shows a successful license installation

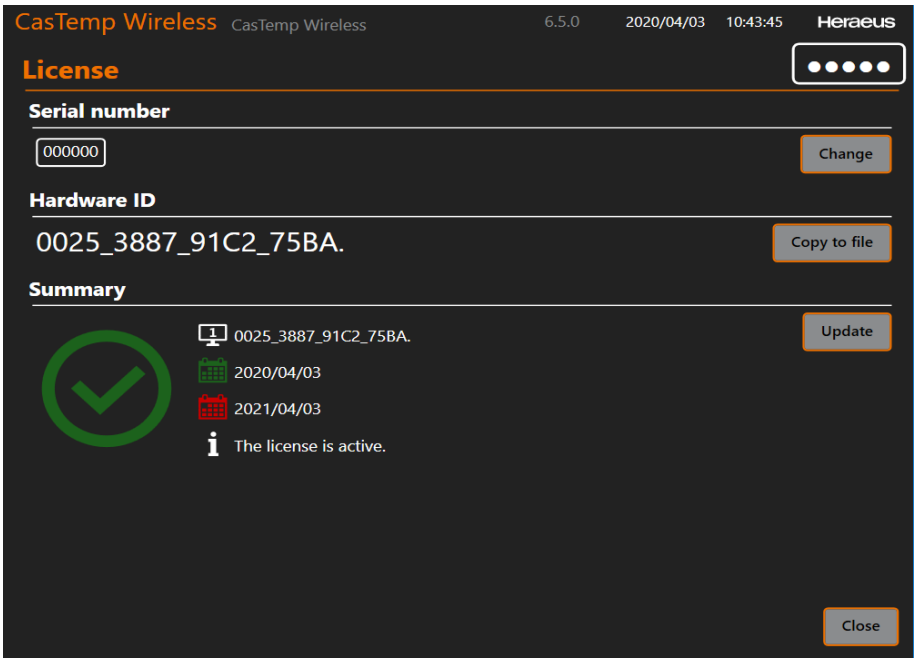


Figure 77: License Screen

The following messages will appear if the license is not installed correctly:

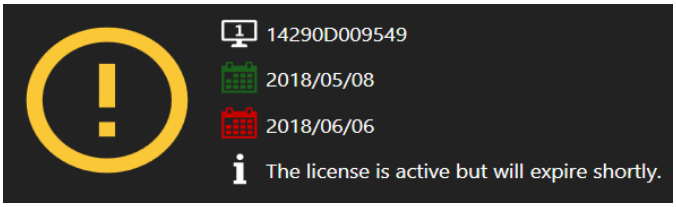


Figure 78: license is active but will expire shortly

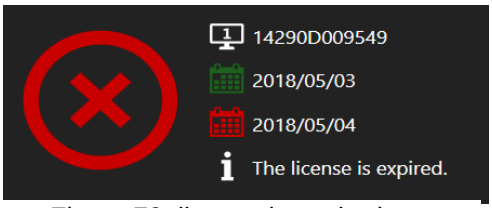


Figure 79: license is expired

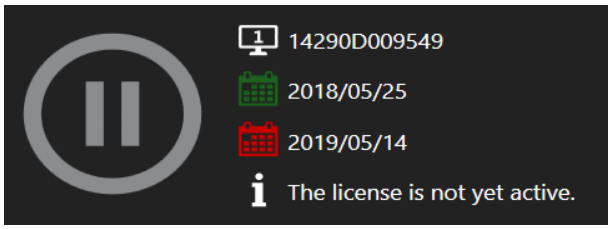


Figure 80: license is not yet active

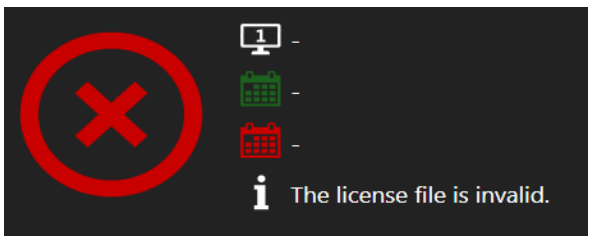


Figure 81: license file is invalid

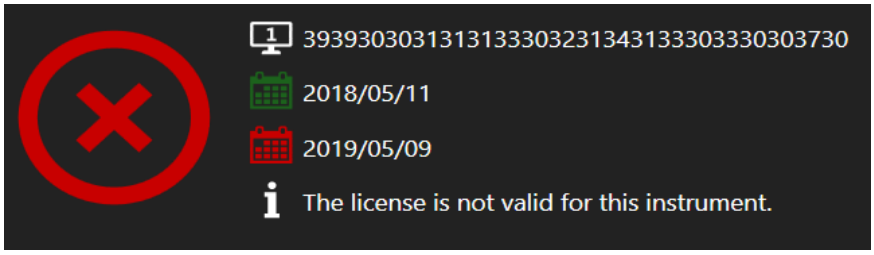


Figure 82: license is not yet valid for this instrument

When the license is due for renewal, the following message will appear on screen:

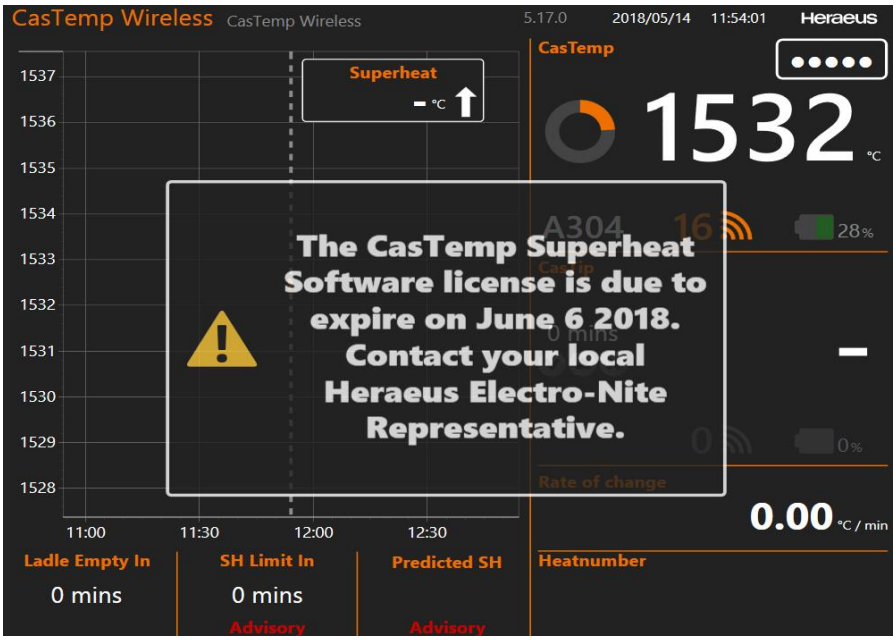
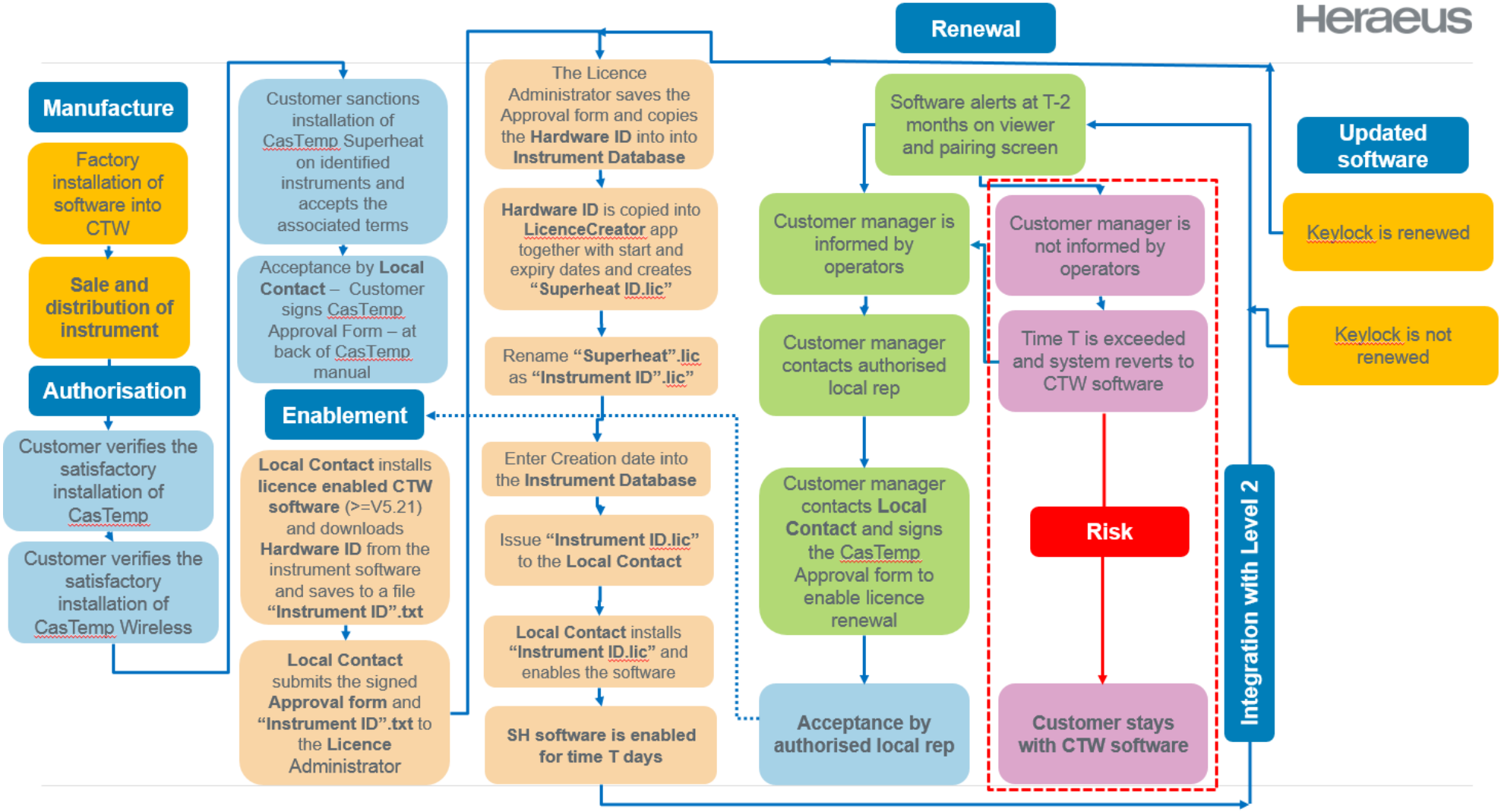


Figure 83: license renewal due

9.6.1 License Code

The following flow chart explains the method of obtaining a Superheat license


Heraeus
Manufacture
Factory installation of software into CTW
Sale and distribution of instrument
Authorisation
Customer verifies the satisfactory installation of CasTemp
Customer verifies the satisfactory installation of CasTemp Wireless
Customer sanctions installation of CasTemp Superheat on identified instruments and accepts the associated terms
Acceptance by Local Contact – Customer signs CasTemp Approval Form – at back of CasTemp manual
Enablement
Local Contact installs licence enabled CTW software (>=V5.21) and downloads Hardware ID from the instrument software and saves to a file "Instrument ID".txt
Local Contact submits the signed Approval form and "Instrument ID".txt to the Licence Administrator
The Licence Administrator saves the Approval form and copies the Hardware ID into into Instrument Database
Hardware ID is copied into LicenceCreator app together with start and expiry dates and creates "Superheat ID.lic"
Rename "Superheat".lic as "Instrument ID".lic"
Enter Creation date into the Instrument Database
Issue "Instrument ID.lic" to the Local Contact
Local Contact installs "Instrument ID.lic" and enables the software
SH software is enabled for time T days
Renewal
Software alerts at T-2 months on viewer and pairing screen
Customer manager is informed by operators
Customer manager contacts authorised local rep
Customer manager contacts Local Contact and signs the CasTemp Approval form to enable licence renewal
Acceptance by authorised local rep
Customer manager is not informed by operators
Time T is exceeded and system reverts to CTW software
Risk
Customer stays with CTW software
Updated software
Keylock is renewed
Keylock is not renewed
Integration with Level 2

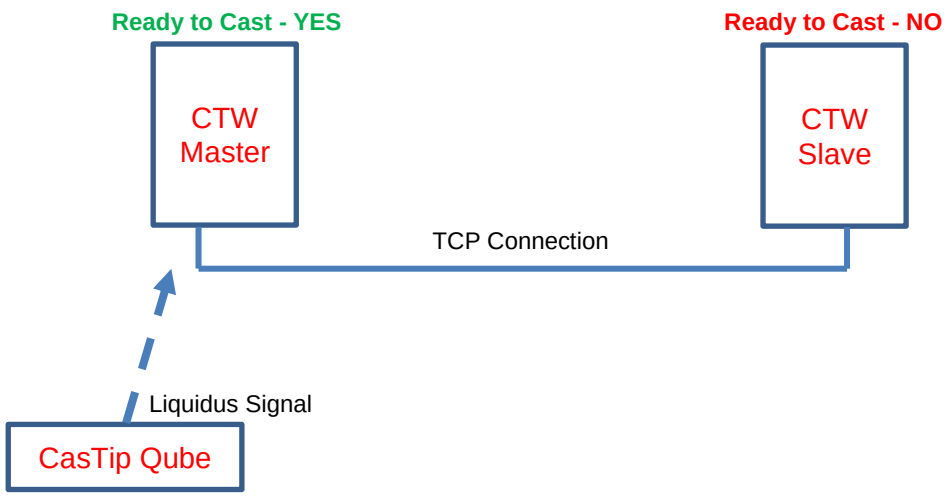
9.7 Dual System Set up

CasTemp Superheat requires the use of a QUBE to take a measurement using a CasTip. Where two CasTemp Wireless instruments are used on one casting machine, CasTemp Superheat software has the ability to internally transfer messages between instruments which means there isn't a requirement to have two CasTip QUBEs thus reducing the complexity of the system. In order to use this feature the following set up needs to be utilised:

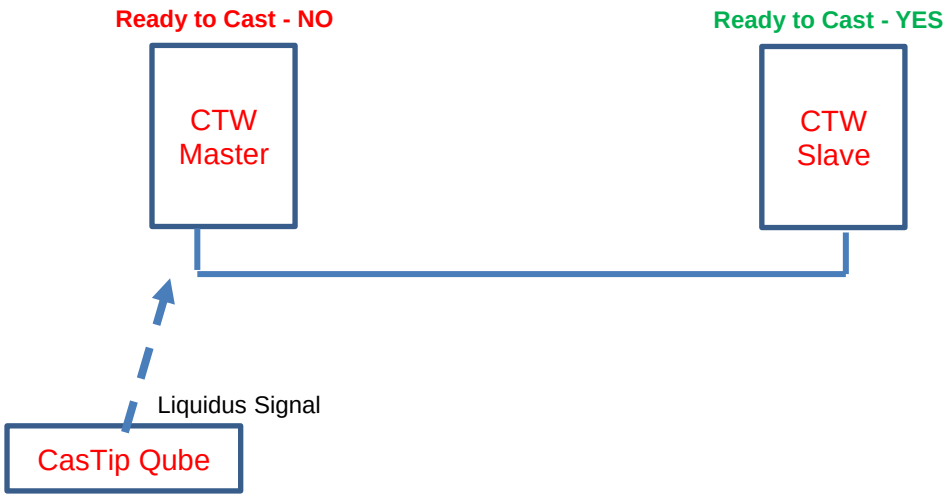
- Connect the two instruments via TCP IP or ensure on the same network
- Set the IP address on the Master instrument
- Set the IP address on the slave instrument and tell this instrument to be a slave

Ready to cast telegram is very important in this mode as this is the instruction that tells the instruments which one should display the measured liquidus. See the following example to see how ready to casts tells the dual setup which instrument should display the liquidus.

Example One – CasTemp Wireless Master will display the Liquidus value



Example Two – CTW Slave will display the Liquidus value



9.7.1 How to set the IP address of the CasTemp Wireless instrument

The IP address of the CasTemp Wireless instrument will only be set once a physical connection has been established. To set the IP address the following steps should be taken:

1. Identify which LAN port the connection has been made through.
    a. LAN port 1 is the recommendation as LAN port 2 may be disconnected or connected to Ethernet IP. If using LAN port 2 ensure connection is to the CPU inside the instrument.

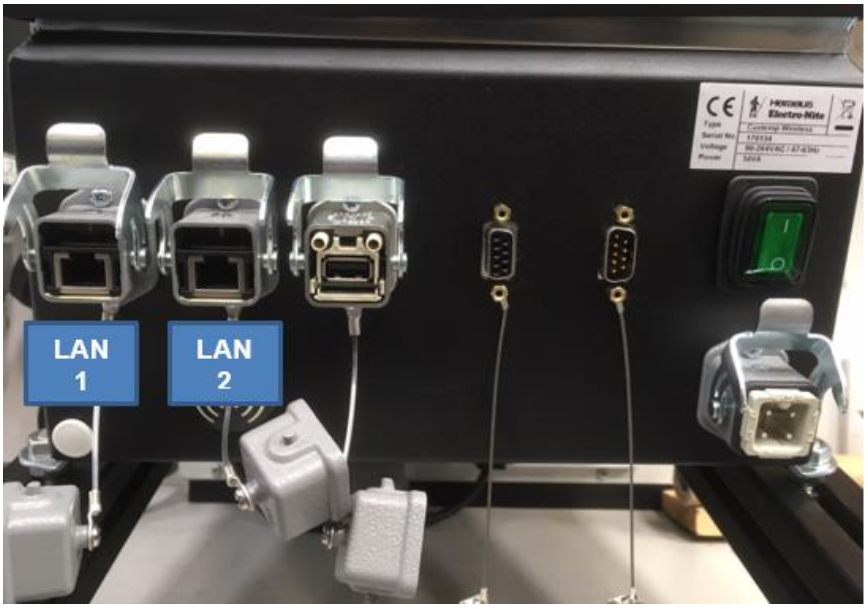


Figure 84: 1st edition model CasTemp Wireless Instrument

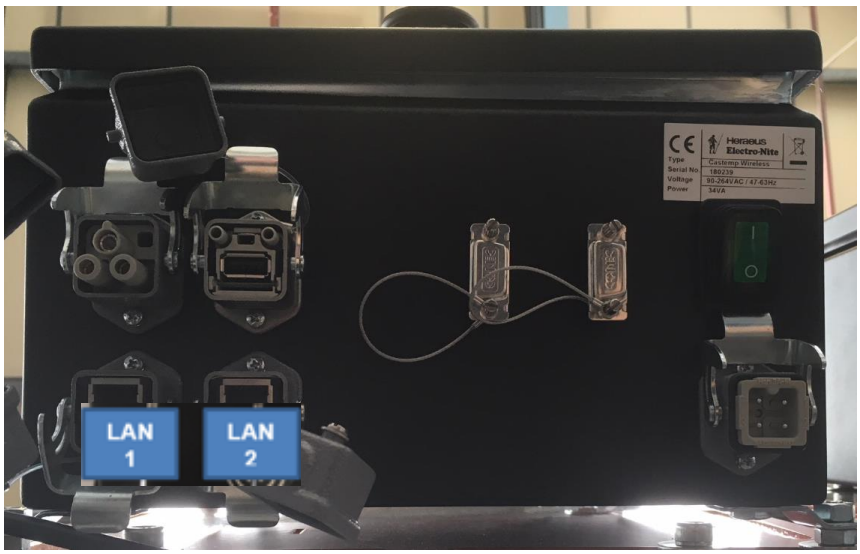


Figure 85: 2nd edition model CasTemp Wireless Instrument

2. Once the LAN port is established on both instruments and they are connected together, the IP addresses of each instrument can be set.
3. Access the CasTemp Wireless instrument menu screen (when not paired to a CasTemp) using the “24816” password.
4. Then click the “settings” on the menu and the “LAN 1” or “LAN 2” depending on which port connection is made to. This will give the following options:

Settings	Default	CasTemp Superheat Mode
IP Address		169.254.0.1
Subnetmask		255.255.255.0
Gateway		10.1.1.1
DHCP enable	CHECK	UNCHECK

5. As a default, DHCP will be checked which will grey out the IP Address, subnet mask and gateway.
    a. To be able to set these values DHCP must be unchecked.
6. Set the required IP address on both instruments and press save on both instruments.
7. To confirm that the IP address has been set correctly the following can be done:
    a. Access the CasTemp Wireless instrument menu screen (when not paired to a CasTemp) using the “24816” password.
    b. And click “operating system” this will load command prompt.
    c. Type into command prompt “ipconfig” and press enter. This will show the instruments set IP address/es.
    d. Once happy that both IP addresses are set, type “ping (IP address of instrument you want to connect too)” into command prompt the press enter. This will then tell you if connection is successful or failed.
        i. Example “ping 168.254.0.1”

9.7.2 How to set the instrument to slave

Once a connection is established one instrument needs to be set to slave.

- Access the CasTemp Wireless instrument menu screen (when not paired to a CasTemp) using the “24816” password.
- Click “settings”.
- In the “instrument” page the “enable slave mode” must be selected on one of the instruments.

9.8 How to set up and use the QUBE CasTip

9.8.1 How to change the PAN ID of the Qube CasTip

To change the PAN ID of the QUBE CasTip first open the battery compartment and insert the battery. The firmware version will flash up followed by the current pan ID. Once the pan ID is shown press and hold the small black button next to the display until this value starts to flash let go of the button at this point. Rotate the QUBE CasTip to the direction you would like the pan ID to go, rotate anti clockwise for reducing pan ID and clockwise for increasing pan ID then press the small black button until you reach the required pan ID. Once required pan ID is displayed waiting for the “Set” to be displayed and press the black button the final screen will say “yes” to confirm, again press the black button to complete the set up.

If connection has been completed successful a GREEN wireless light should be shown on the QUBE CasTip, if this is RED then the setup is incorrect. If this LED is AMBER the setup is correct but wireless safety lock may be preventing the successful pairing of the QUBE CasTip.

9.8.2 CasTip Safety Mode

CasTip safety mode ensures that the instrument can be locked to one QUBE CasTip. This is to prevent a QUBE at another location accidently connecting to the system. The safety mode can be found in Settings under Instrument. The safety mode can be in three different states:

Safety Mode	Comment
Disabled	When the safety mode is disabled, any single QUBE CasTip on the correct Location ID can connect to the system. Although no other QUBE can connect whilst a connection exists; the connection is broken when the QUBE enters sleep mode, is removed out of range or powered down
Activated and locked	The system has successfully locked automatically to a connected QUBE CasTip. No other QUBE can connect, even if the connected QUBE is powered down. Module lock must be unselected if you would like to change to another QUBE CasTip.
Activated but not locked	Deselect Module lock if you would like to change to another QUBE Cas Tip. Once the setting is saved, the instrument automatically locks onto the next connected QUBE and no other QUBE CasTip will be able to connect.

Important: When making changes, Save settings AND close the menu to return to the pairing screen
To change to another QUBE:

- Set the QUBE to the location ID of the instrument. It will connect (GREEN LED) if safety mode is deactivated and no other QUBE is already connected.

If a new QUBE does not connect (shows AMBER signal LED instead of GREEN), then the safety mode is enabled and the instrument is locked to another QUBE

- Open Settings and Instrument menu
- Uncheck QUBE CasTip module lock
- Save Settings AND close menu to return to the pairing screen

The new QUBE should now go through a short LED sequence as the instrument locks to it

9.8.3 Immersion Procedure and Signalisation

The QUBE CasTip offers on board signalisation.
To activate the Qube any movement of it will cause it to wake up. The connection light will illuminate and remain green whilst paired and awake.
A CasTip sensor can then put on the probe holder and the measurement light will go green if it correctly fitted. The correct orientation of the sensor to the notch allows for only one position for a correct connection. This connection must show the CasTip notch and the probe holder pointing vertically to the sky. This is important to ensure that during immersion, withdrawal and measurement the sensor is filled correctly and remains filled:

1. In order that whilst the sensor sample is cooling and it remains partially liquid in the core that it does not drain out
2. To avoid the possibility of steel draining out in an uncontrolled manner leading to a safety issue
3. To avoid a void result as a liquidus arrest cannot be achieved.

The following LED colours on the measurement light are used to indicate the following dipping steps, default timings are also shown:

LED Colour	Action	Approximate duration:
Green	CasTip sensor is connected	0 seconds
Orange	CasTip sensor is immersed and measuring over 400°C	2 seconds
Red	Remove CasTip sensor from melt	6-7 seconds
Orange	Continuing to measure liquidus	
Red	Measurement complete	Configurable ~ 15-25 seconds

Light Sequence	
Sensor not Connected	
Sensor Connected	
Filling Sample Chamber	
Remove Sensor from Steel	
Measuring: Leave sensor on lance	
End of Measurement: Remove Sensor from Lance	

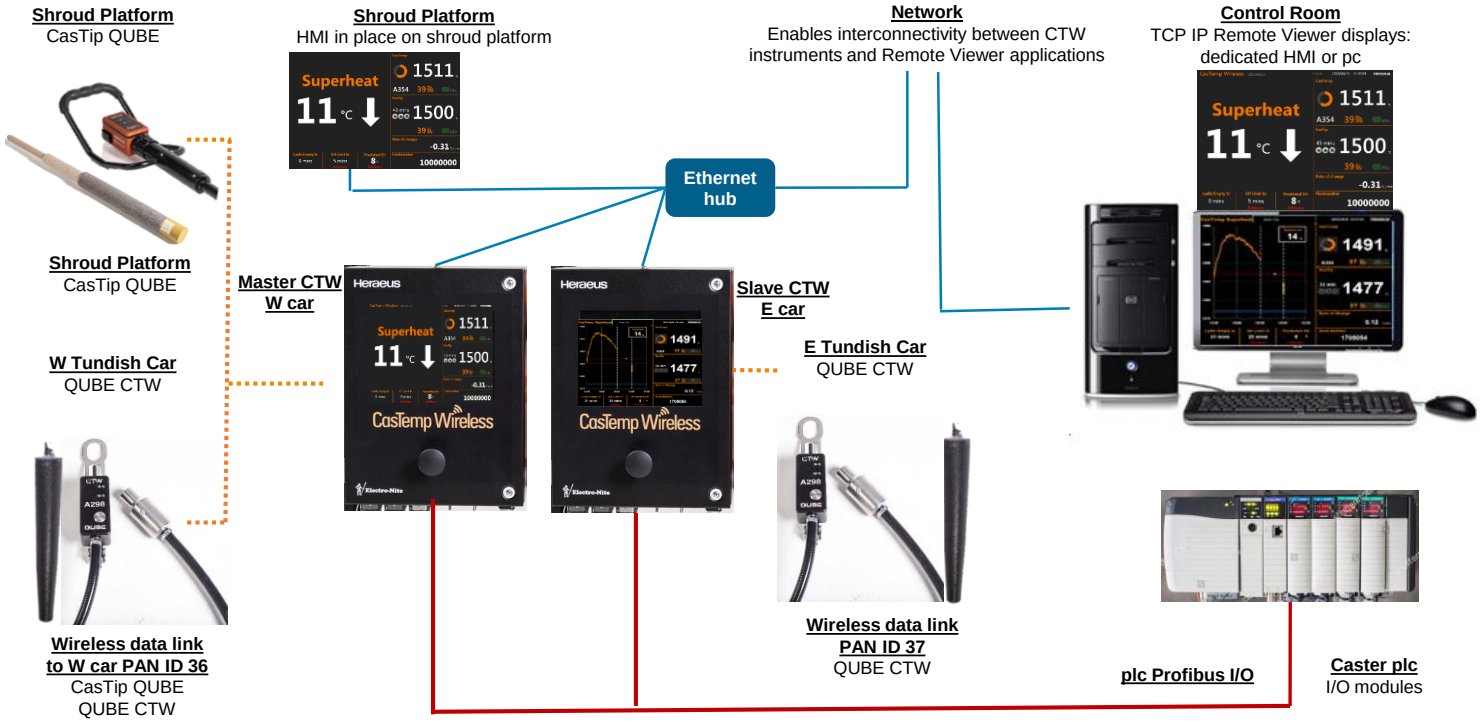
9.9 Measuring Period

CasTemp Superheat software processes a lot of back ground calculations which means that the CasTemp Wireless instrument is busy between measurements. As a default the measuring period is set at 15000ms.

9.10 Prediction explanation

CasTemp Superheat software requires a certain amount of information in order to produce a prediction

- CasTip Liquidus LT is required for Superheat Prediction
- A declining rate of change in liquid steel temperature
- Superheat Prediction to end of ladle is dynamically predicted from the CasTemp trend



Control room pc
Remote Viewer
Manual I/O via pc (trials)
Temporary data connection with plc (trials)

Figure 86: Overview SuperHeat System

9.11 Superheat Screen Explained

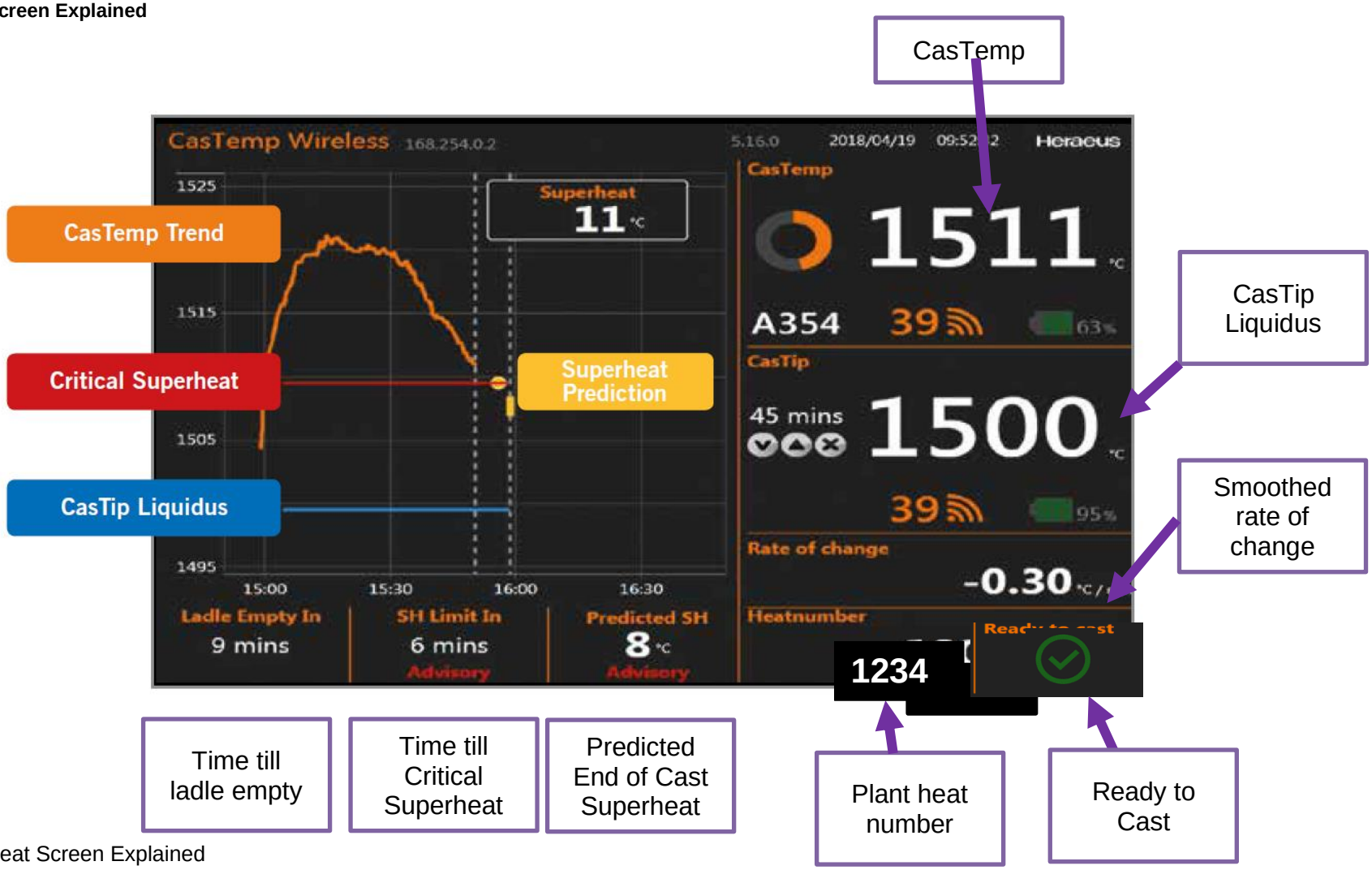


Figure 87: Superheat Screen Explained

9.12 Superheat Trial Set up

A limited time Superheat trial can be run by the plant operators manually inputting telegrams to the CTW instrument from a connected pc via a small windows based client application, “Level2 Plant Simulation”, which can be ran alongside a Remote viewer client. The tool allows a demonstration of the systems capability without requiring level 2 connection

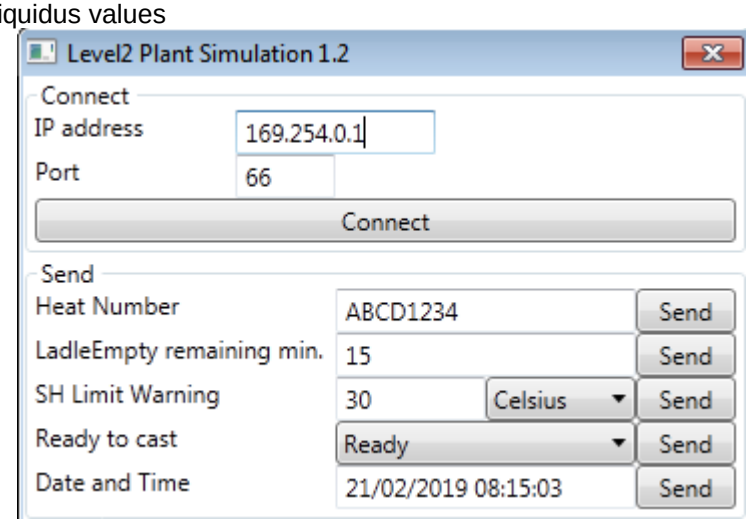
Set up as follows:

Connect a PC and CTW instrument on a network or peer to peer. Follow section 5.2.7 LAN 1 & 2 parameters for the CTW instrument, and section 5.3 to establish the network connection, ensuring that the two devices are set to IP addresses in the same domain.

Make a TCP IP server on the instrument, see section 6.2.2 and bind it to a telegram, see section 6.3. Ensure that “Allow input” is checked on the server. Note the port setting of the server.
Open the plant simulation tool on the pc, and enter the IP address of the instrument and the port setting of the server. Click connect. An example is shown below

Setting	Example	
CTW instrument IP address	169.254.0.1	
Port number set during set up	66	
IP Address of input (laptop)	169.254.0.2	

Type in the required variable and press “send”. Note that “Ready to Cast” status “ready” is required to visualise CasTip Liquidus values



Conditions:

- LAN connection established
- Binding made
  - TCP IP Server accepting inputs
  - Telegram (use default)
- the instrument is in Superheat mode (section 5.2.2 and 9.8)
- a QUBE CTW module is paired and connected
- then inputs can be sent to the CTW instrument system.

Please see the table below for notes on these inputs:

Input	Comments	Laptop inputs
Heat Number	This must be 8 bytes in length so “12345678” you can input shorter lengths but these must start with spaces e.g. “ 123” this example has 5 spaces in front of the heat number	Alphanumeric
Ladle Empty	This can be minute value from 0 to 1000 but must be in minutes remaining format. E.g. 15	
SH Limit warning	This can be set as °C or °F	
Ready to Cast	this has two options – ready/not ready	Ready
Date and Time	Use the format shown above	**DO NOT USE**

Note that altering time and date will temporarily disrupt the trace visibility and SH prediction, so changing this is not recommended.

The tool will remain connected if the instrument is unpaired, and if the network cable is disconnected and reconnected, and even if the instrument is rebooted. It may take a short time for the connection to re establish after re boot.

More than 1 instance of the plant simulation tool may be opened and connected to the same server, and more than 1 server opened on the instrument, connected to a different port

10 Appendices

10.1 Appendix 1: EC Declaration of Conformity Certificates

Quality Management
Conformity declaration Qube CTW

Heraeus

FC CE

EC Declaration of Conformity

We: **Heraeus Electro-Nite (UK) Ltd.**

Address: **Carlisle Close**
Chesterfield, S41 9ED
United Kingdom

Declare under our sole responsibility that the product:

Qube CTW (UCS: 20837611 containing module UCS: 31100155)

Fulfils the requirements of the following standards:-

EMC Directive 2014/30/EU
FCC Title 47 part 15
Radio Equipment Directive (RED) - 2014/53/EU

And conforms to the executed test reports and therefore complies with the regulations of the directives.

The following harmonised standards were used for the evaluation tests:-

Immunity for Industrial environments
(According to EN 301 489-1:V1.9.2 and EN301 489-17:V2.2.1)
EN61000-4-2: 2009 Electrostatic discharge ESD immunity
EN61000-4-3: 2006 Radiated RF electromagnetic field immunity

Emission for industrial environments
(According to EN 301 489-1:V1.9.2 and EN301 489-17:V2.2.1)
EN55022: radiated emissions

Radio Equipment Directive (RED) - 2014/53/EU

EN 60950-1:2006 +A11:2009 +A1:2010 +A12:2011 +A2:2013: Low voltage equipment safety
EN 301 489-1 v2.2.0 (2017-03) EN 301 489-17 v3.2.0 (2017-03): Protection requirements – Electromagnetic compatibility
EN 300 328 v2.1.1 (2016-11): Means of the efficient use of the radio frequency spectrum (ERM)

FCC Title 47 part 15
FCC Title 47 part 15: radiated Emissions

Third body assessment was done by an accredited laboratory (BELAC) and a Technical Construction File (TCF) is available, describing the apparatus, the procedures used to ensure conformity and a technical report containing test data.

Delegates for reviewing the technical information and confirming requirements are met:

Mark Watts (Operations Manager) Date: 18/9/17 Steve Pagden (R&D Engineer) Date: 18/9/17

Counter signatory:

Mark Lee (Managing Director) Date: 18/9/17

Heraeus

EG - Konformitätserklärung
EC - Declaration of Conformity

CE

Wir /We **Heraeus Electro-Nite GmbH & Co. KG**

Anschrift / Address **Unter dem Hofe 10**
58099 Hagen
Germany

erklären in alleiniger Verantwortung, dass das Produkt: / declare under our sole responsibility, that the product:

CasTemp Wireless

mit den Anforderungen der Normen / fulfils the requirements of the standard

EMV Richtlinie / EMC Directive	**2014/30/EU**
RED-Richtlinie / Radio Equipment Directive	**2014/53/EU**
Niederspannungsrichtlinie / Low Voltage Directive	**2014/35/EU**
RoHS 2 Richtlinie / RoHS 2 Directive	**2011/65/EU**

und den zugehörigen Prüfberichten übereinstimmt und somit den Bestimmungen entspricht.
and the taken test reports and therefore corresponds to the regulations of the directive.

Die folgenden Praxisnormen wurden zur Beurteilung herangezogen:
The following harmonised standards were used for the judgement of the product:

EMV Richtlinie / EMC Directive: (Elektromagn. Verträglichkeit / electromagnetic compatibility)

Emission according ETSI EN 301 489-1 V1.9.2 & ETSI EN 301 489-17 v2.2.1

Radiated Emission	Enclosure Port	EN 55022:2006 + A1:2007
Conducted Emission	AC Power Port	EN 55022:2006 + A1:2007
Conducted Emission	Telecomm. Port	EN 55022:2006 + A1:2007
Harmonic Current Emissions	AC Power Port	EN 61000-3-2:2006+A1:2009+A2:2009
Voltage Changes, fluctuations and Flicker		EN 61000-3-3:2008

Immunity according ETSI EN 301 489-1 V1.9.2 & ETSI EN 301 489-17 v2.2.1

Electrostatic Discharge	Enclosure Port	EN 61000-4-2:2009
Voltage Dips and Interruptions	AC Power Port	EN 61000-4-11:2004

Immunity according EN 61000-6-2:2005 + C11:2005

RF Immunity	Enclosure Port	EN 61000-4-3:2006 + A1:2008+A2:2010
Electrical Fast Transients	AC Power Port	EN 61000-4-4:2012
Electrical Fast Transients	Telecomm. & Signal Ports	EN 61000-4-4:2012
RF Common mode	AC Power Port	EN 61000-4-6:2014
RF Common mode	Telecomm. & Signal Ports	EN 61000-4-6:2014
Voltage Dips and Interruptions	AC Power Port	EN 61000-4-11:2004
Surges	AC Power Port	EN 61000-4-5:2014

Niederspannungsrichtlinie / Low Voltage Directive:

Sicherheitsbestimmungen / Safety requirements DIN EN 61010-1:2011-07

Ort und Datum der Ausstellung Place and date of issue	Name und Funktion des Befugten Name and function of authorised person	Unterschrift signature
Hagen 11. Oct 2016	**Gisbert Schockenhoff, Quality Manager**	i.V.

HERAEUS ELECTRO-NITE GMBH & CO. KG QUALITY DEPARTMENT

Conformity Declaration ***QUBE wireless transmitter*** Heraeus

EU Declaration of Conformity

CE

We Heraeus Electro-Nite International N.V.
Address Centrum-Zuid 1105
B-3530 Houthalen, Belgium

declare under our sole responsibility, that the industrial product

QUBE wireless transmitter modules QUBE-T, QUBE-O, QUBE-L, Qube-K, Qube-CasTip

fulfills the requirements of the applicable directives or normative documents.
Test procedures, based on Harmonised Standards, have been carried out by a conformity assessment body for demonstrating product compliance with the essential requirements of following EU Directives:

Radio Equipment Directive (RED) 2014/53/EU

Specific EMC standard for RF transmitting / receiving equipment and services
EN 301 489-1 v2.2.0: Common technical requirements, according RED art. 3.1(b) and EMC art. 6
EN 301 489-17 v3.2.0: Specific conditions for Broadband Data transmission systems, according RED art. 3.1(b)
EN 300 328 v2.1.1: Main emissions standard for 2.4GHz systems, according RED art. 3.2

Low Voltage Directive (LVD) 2014/35/EU

Low voltage equipment safety standard according EN 61010-1:2010
RED Article 3.1a: health and safety according EN 60950-1:2006 +A1:2010 + A12:2011 + A2:2013

Electro Magnetic Compatibility (EMC) Directive 2014/30/EU

Immunity standard according EN 61000-6-2:
EN 61000-4-2:2009: Electrostatic discharges, ESD immunity
EN 61000-4-3:2011: Radiated RF electromagnetic field immunity
Emission standard according EN 61000-6-4:
EN 55022:2011: Conducted emission, RF disturbance characteristics

The product also complies with:

FCC Part 15 (Title 47 of Federal Regulations Code covering EMC)

Radiated emissions; Class A device: marketed for use in commercial, industrial or business environment

Technical Files are available, describing the apparatus, circuit diagrams, parts listing and attestation test reports.

Place and date of issue	Name and function of authorized person(s)	Signatures
Houthalen, **April 29th; 2019**	**Luc Lammerant** **Industrialization Mgr. instruments & manipulators** **Veerle Hendrickx** **Head of Finance**	

Heraeus Electro-Nite Intl. NV
Centrum-Zuid 1105
B-3530 Houthalen, Belgium

Phone: +32(0)11600211
Fax: +32(0)11600400
E-Mail: info.electro-nite.be@heraeus.com

Electro-Nite

Material Declaration ***QUBE CASTIP wireless*** Heraeus

Material Content Declaration

We **Heraeus Electro-Nite International N.V.**
Address **Centrum-Zuid 1105**
B-3530 Houthalen, Belgium

declare under our sole responsibility, that the industrial instrument

QUBE CASTIP WIRELESS TRANSMITTER

contains the Digital Transmission System Module RM024, manufactured by 'Laird Connectivity'.
Laird Module description: **Laird type: RM024-P10-C-30**
FCC/IC: Model: RM024
FCC ID: KQL-RM024
IC: 2268C-RM024
Frequency Band 2400-2483.5 MHz

Heraeus article codes: as single unit = 31090020 / as kit = 31010001.

Place and date of issue	Name and function of authorized person(s)	Signature
Houthalen, **April 19th; 2019**	**Mr. Luc Lammerant** **Industrialization Manager** **Instruments & Manipulators**	

Heraeus Electro-Nite IntL NV
Centrum-Zuid 1105
B-3530 Houthalen, Belgium

Phone: +32(0)11600211
Fax: +32(0)11600400
E-Mail: info.electro-nite.be@heraeus.com

Electro-Nite

The datasheet and official release documents for the Qube Laird Module and frequency range are available on request.

10.2 Appendix 2: Safety statement

The design of Qube CTW module ensures that in normal operating circumstances the Qube CTW module can be mounted and operate with safety in environments within its design specification whilst being in relatively close proximity to a steelmaking tundish. Installation instructions can be found in Section 3.

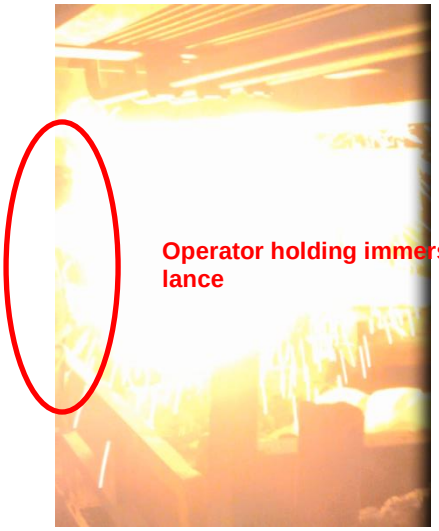
A steel plant environment means that there may be circumstance in which the Qube CTW module is exposed to conditions outside of its designed operating specification. This may result in reduced performance, or in extreme, damage to the wiring, electronics and failure of the battery.

Risk assessment of the Qube CTW module in the tundish environment has identified 3 scenarios leading to module failure which could impact upon personnel. This document outlines what might be expected in failure and how to minimise such exposure:

- Overheating of the Qube CTW module up to and above~ 200^{0}C can lead to battery failure which may result in a small explosive release of smoke and fume, but no other ejection of particles, which are contained within the module. Significant exposure to smoke and fume may be harmful, but actual harm is unlikely; as the ejection is of limited quantity and radius of ejection is approximately 1m

- On exposure of Qube CTW module to immersion into molten metal, a small eruption of a few seconds duration may be experienced which causes an ejection of small sparks/particles over a radius up to 2m; equivalent to the initial immersion of a tundish hydrogen sensor. Stills from a video show an operator completely surrounded by sparks for a short period during the routine occurrence of a hydrogen sensor immersion.

Maximum eruption of Qube CTW during test



Eruption from Tundish 1 sec after immersion of a hydrogen sensor

- The hose and cable system of Qube CTW module will be damaged if the tundish is moved before disconnection from CasTemp. The hose will part from either module or sensor contact block at a load of ~ 60kgf. The module could fall if the recommended mounting system is not used

Although tests results indicate that the severity of the hazards posed by these events is unlikely to cause harm to personnel wearing appropriate PPE; it is strongly recommended that the user assesses and minimises the risk of Qube CTW module being exposed to conditions outside of its designed operating specification.

Operating Specification:

	Minimum Temperature	**Maximum Temperature**
Recommended Operating Temperature Range	**-20^{0}C**	**60^{0}C**
Maximum Operating Temperature Range (may reduce battery lifetime)	**-30^{0}C**	**85^{0}C**
Battery Charging	**0^{0}C**	**60^{0}C**
The sensor contact block has a maximum operating temperature of 200^{0}C		
The wireless transmission system will not operate at temperatures above 85^{0}C		
The Qube CTW module must NOT be exposed to temperatures above 85^{0}C to avoid risk of permanent damage to electronics and batteries		

Mitigating Safety Features

A range of features to reduce the frequency and severity of failure are encompassed in the design of Qube CTW module

Primary Safety

- Qube CTW module employs electronic circuitry to protect against short circuits, overcharging and prevention of charging and operation at temperatures outside of specification
- The size and capacity of the battery cells has been kept to the minimum required to meet operational requirements
- Lithium Ferro phosphate battery chemistry is employed due to its inherently more benign failure modes compared to alternative Li and Li-ion cell chemistries

Secondary safety

- The Qube CTW module is made of robust CNC aluminium which will withstand battery failure at temperature (at least up to~ 250^{0}C), preventing release of particles
- The Qube CTW module vents gases through release of its circumferential seal at elevated temperature, directing them away from the most likely position of personnel
- Smoke is released before failure. Keep Away.
- No special firefighting precautions are required
- The CTW Qube module poses no significant hazard after failure or when cooled. Appropriate disposal methods should be followed
- The Qube CTW module hose system will break free from the Qube CTW module or sensor contact block at a loading ~60kgf in the event of the tundish being lifted away with

Qube CTW module still connected to CasTemp. A properly secured Qube CTW module locating bracket system will not fail at this loading so the Qube CTW module is not expected to fall from its location position

- Each Qube CTW module is clearly labelled on its rear surface with required regulatory information including also a clear statement of maximum temperature:

! T max 85^{0}C !

- The CasTemp Wireless instrument will indicate when a connected Qube CTW module is approaching its maximum service temperature of 85^{0}C

Risk Assessment Process

Following a risk assessment process in the deployment of Qube CTW module will help ensure that exposure of Qube CTW module to potentially damaging external events is minimised such that its already low potential to cause of harm can be virtually eliminated.

An example process is appended, providing examples of simple control measures to mitigate the risk of damage to the module.

Conclusion

- The primary cause of hazard in use of Qube CTW module is exposure of the module to some adverse external event which moves it outside of its normal operating specification.
- The design of Qube CTW module includes a number of primary and secondary features which act to limit its inherent hazard potential to lie within those typically accepted in the steel casting environment.
- For example, immersion of Qube CTW module into molten steel resulted in a hazard level equivalent to the routine daily event of immersing Tundish hydrogen sensors.
- Existing caster PPE should provide sufficient protection for personnel in all identified scenarios.
- The risk of exposure to hazard can be further reduced through implementation of simple control measures by following a risk assessment process.

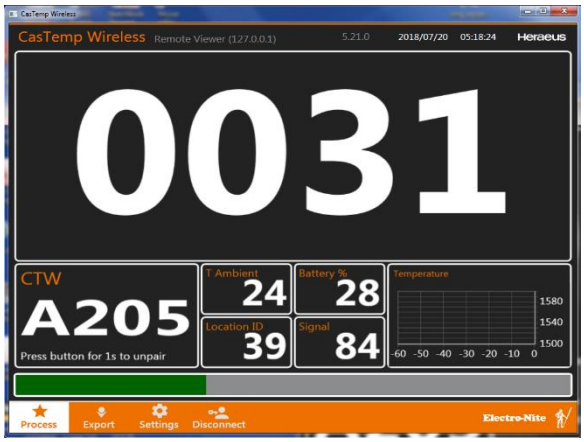
Recommendation

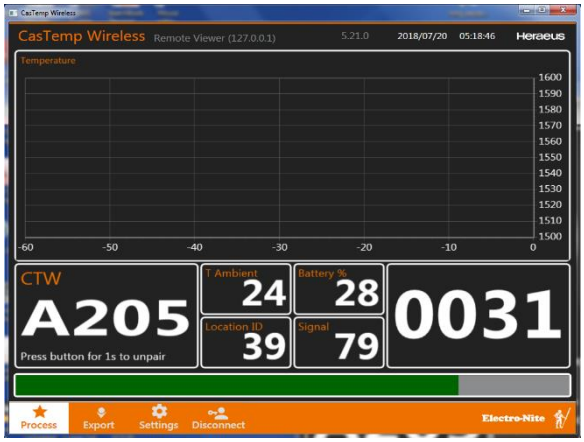
The user should carry out a risk assessment process and introduce control measures to minimise/ eliminate the exposure of Qube CTW module to adverse external events, improving safety, cost and system reliability.

Scenario	**Qube CTW is exposed to radiant heat or contact with a hot surface** ***Example: Spill of molten metal or slag which radiate heat to surrounding areas***	**Qube CTW is used adjacent to a tundish with no special precautions**	**Qube CTW is not disconnected from CasTemp before the tundish is lifted away; no control measures in place**
Event	**The Qube CTW reaches >200^{0}C and the battery fails with release of fume and smoke**	**The Qube CTW falls into molten steel** • ***No control measures in place*** • ***Not using supplied mounting brackets***	**Qube CTW is not disconnected from the CasTemp sensor before the tundish is lifted away.** • ***No control measures in place*** • ***Not using supplied mounting brackets***
Consequence	• Some prior warning release of smoke Release of smoke at failure • Environment around Qube CTW is also heated, self limiting personnel exposure • **Hazard rating: 0 1 2 3 4 5 6 7 8 9 10 (Local heat will limit operator exposure)**	• A small short eruption occurs which causes an ejection of particles equivalent to Tundish Hydris immersion • **Hazard rating: 0 1 2 3 4 5 6 7 8 9 10 (Similar events are routine)**	• Failure of the hose attachment occurs at a loading of ~60kgf • OR Qube CTW or sensor head is dragged to the ground • **Hazard rating: 0 1 2 3 4 5 6 7 8 9 10 (Injury is unlikely)**
Potential Harm	Exposure to fume and smoke at a distance <1m./ Normal PPE (clothing, helmet visor, should offer sufficient protection ***Harm: Discomfort from fume/smoke <1m, No Harm >1m***	Exposure to molten metal splash ~<=2m from event: same as Hydris Immersion ***Harm: Minor Burn <2m, No harm > 2m***	Qube CTW mounted at ~2m from floor Injury from falling object < 2m from floor ***Harm: Minor Injury***
Control Measure	• Secure Qube CTW so it can't fall into hot areas • Move Qube CTW away from the potential risk • Shield Qube CTW from radiated heat sources • Enforce PPE • Personnel Training and Awareness • Review Effectiveness of Control Measures	• Secure or move Qube CTW away from tundish to eliminate the risk • Enforce PPE • Personnel Training and Awareness • Review Effectiveness of Control Measures	• Mount Qube CTW on the supplied bracket • Interlock tundish movement to CasTemp connection • Other tundish systems have to be disconnected prior to tundish movement • Enforce PPE • Personnel Training and Awareness • Review Effectiveness of Control Measures
Residual Risk after implementation of Control Measures	• **Severity :Low** • **Liklehood: Unlikley** • **Hazard rating: 0 1 2 3 4 5 6 7 8 9 10 (Control measures substantially reduce residual hazard)**	• **Severity :Low** • **Liklehood: Unlikley** • **Hazard rating: 0 1 2 3 4 5 6 7 8 9 10 (Control measures probably eliminate residual hazard)**	• **Severity :Low** • **Liklehood: Possible (Subject to Human Error)** • **Hazard rating: 0 1 2 3 4 5 6 7 8 9 10 (Control measures result in small residual hazard)**

10.3 Appendix 3: Remote Client Installation and set up

The CasTemp Wireless instrument can be placed on a network and viewed remotely via a Remote Client application installed on PC devices. The Remote Client allows for many different users to view the CasTemp Wireless instrument and download data; providing similar functionality and visibility as the screen on the instrument.





Key features of Remote Client

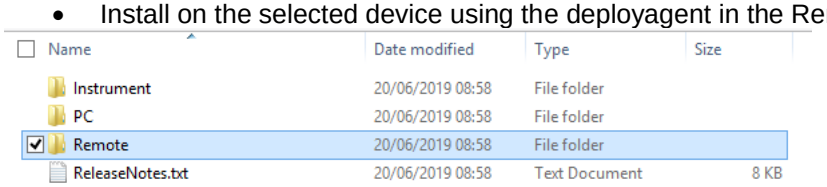
- Up to 9 such client applications can be connected to a single instrument
- Multiple instances can be run on a single pc looking at different instruments
- As per the instrument, graphical or digital displays can be run
- Data download can be achieved without disconnecting the instrument, however this feature may slow the instrument so manual selection of data has been used to limit the amount selected
- The Remote client will automatically reconnect to the instrument in the event of the instrument closing. However the remote client must be reset if it is closed and reopened
- A graphical display can be run on the remote client, whilst a digital display can be run on the instrument

Application

- The remote client can be run in the control room, providing a larger screen format than offered by the instrument, and by using multiple screens connected to the pc, 2 or more instruments may be viewed
- The remote client may be run on an HMI at a remote location, for example at preheater station or shroud platform to give local measurement information

Installation

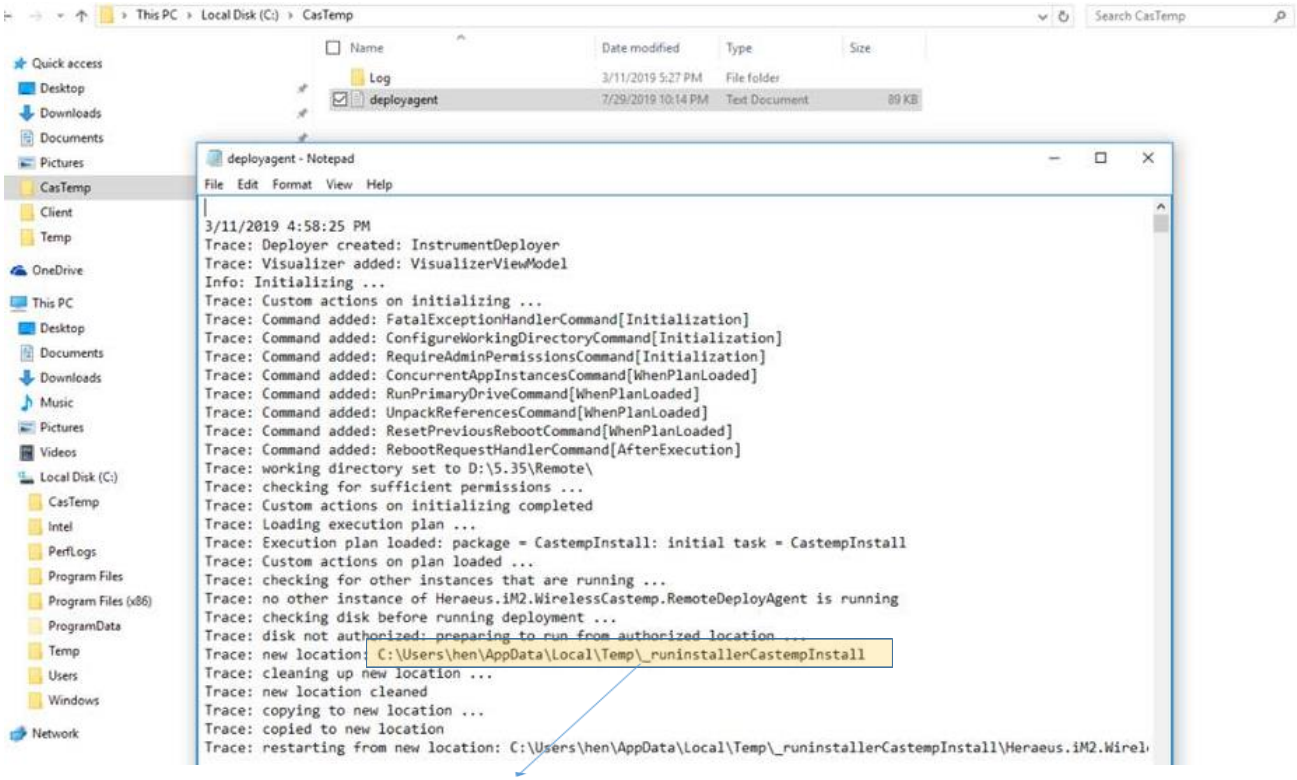
- Install on the selected device using the deployagent in the Remote folder



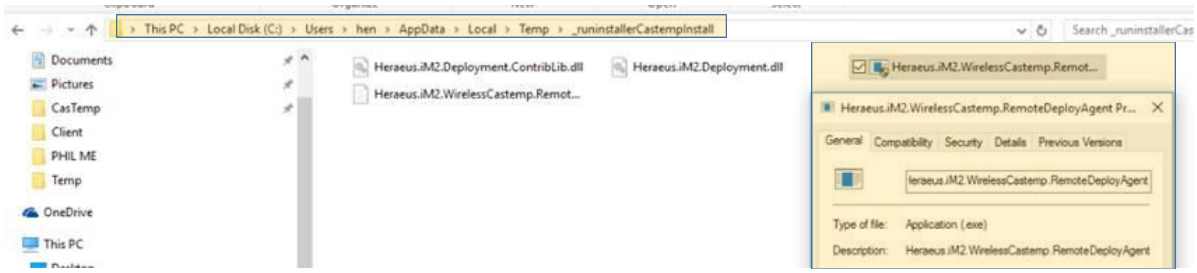
Name	Date modified	Type	Size
Instrument	20/06/2019 08:58	File folder	
PC	20/06/2019 08:58	File folder	
Remote	20/06/2019 08:58	File folder	
ReleaseNotes.txt	20/06/2019 08:58	Text Document	8 KB

On Windows10 machines, the installer may start then immediately close. If so:

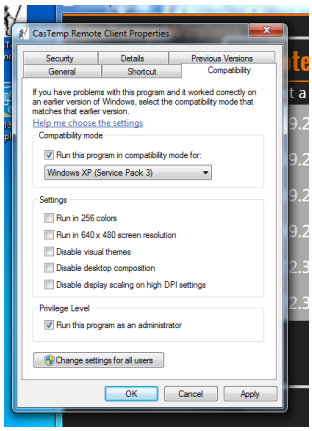
Look in the CasTemp directory and open the deployagent log in Notepad, look for “new location” and copy this address into the browser or otherwise navigate to it



Identify the RemoteDeployAgent .exe file, and run it



- Open the Remote Client via the desktop shortcut. If the Remote Client doesn't open, right click and on "properties"-"compatibility", check "run in compatibility mode" as shown, and "as an administrator"



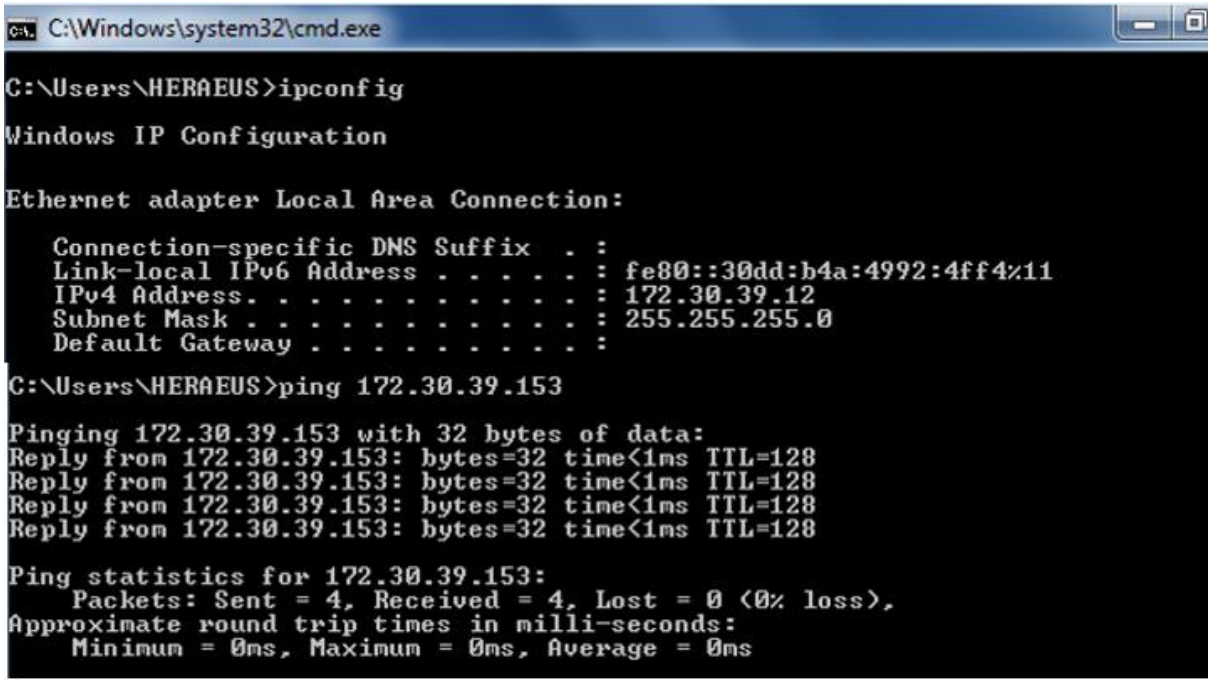
Network

Connect a PC and CTW instrument to the same network. Set the two devices to IP addresses in the same domain. Follow section 5.2.7 LAN 1 & 2 parameters for the CTW instrument, and via the Network Adapter menu in the Network and Sharing Center on the PC, normally found by navigating through Control Panel in Windows.

Referring to the table, in general, each part of the address must match between the two devices if marked as “network” and can vary within the range shown if marked as “host”

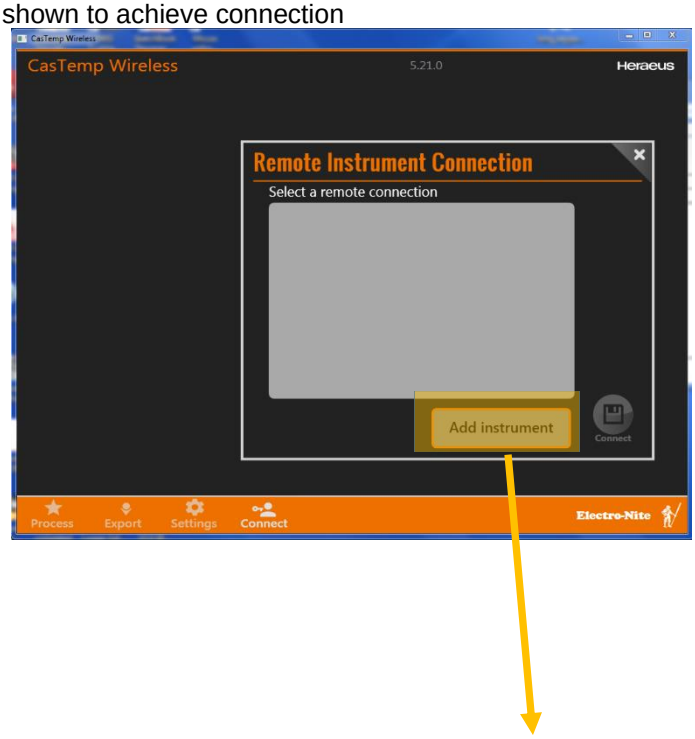
IP address class	Primary domain	1st part: ***172***	2nd part ***30***	3rd part ***39***	4th part ***12***
Class A	1-126	Network (1-126)	Host (0-255)	Host (0-255)	Host (0-255)
Class B	128-191	Network (128-191)	Network (0-255)	Host (0-255)	Host (0-255)
Class C	>=192	Network (≥192)	Network (0-255)	Network (0-255)	Host (0-255)

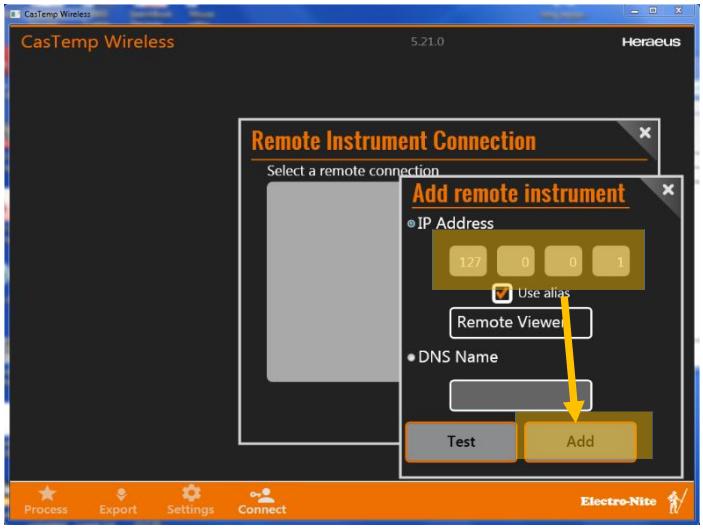
To confirm connection, type “cmd” in the run box of the pc to open a DOS screen, or open the operating system of the instrument (7.2). IPCONFIG will confirm the local ip address and PING will confirm a successful connection.



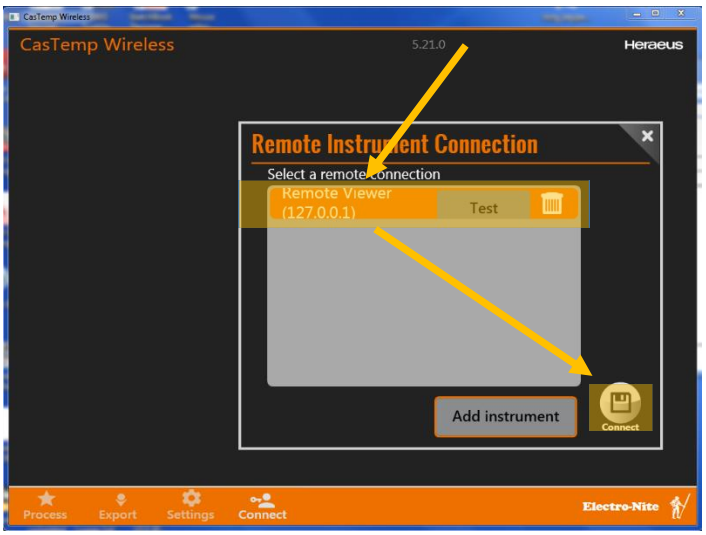
The example shows a successful “PING” result between a PC set to 172.30.39.12 and CTW instrument set to 172.30.39.153.
Note that there may be other network constraints which restrict the range of IP addresses that can be set. Refer to the local administrator as required.

Connection
Ensure that the instrument and Remote client software versions are the same (eg 6.5.0)
Follow the menus as shown to achieve connection





Highlight the required instrument and connect

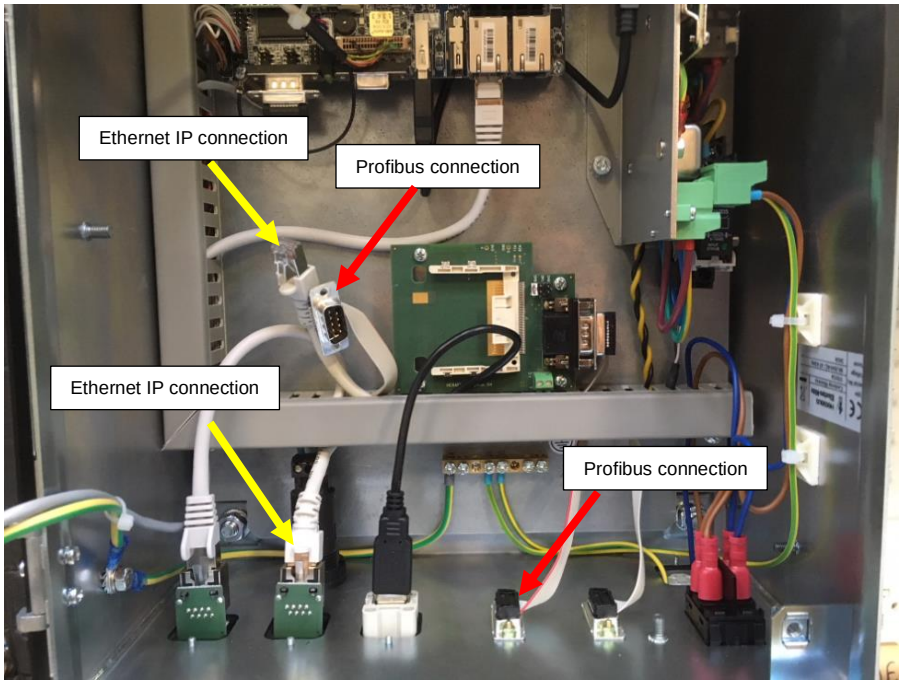


The Remote client screen matches that of the instrument. This can be configured to show a large or a small graph or the CasTemp Superheat application, if this is enabled.

10.4 Appendix 4: Profibus and Ethernet IP Module Installation and set up

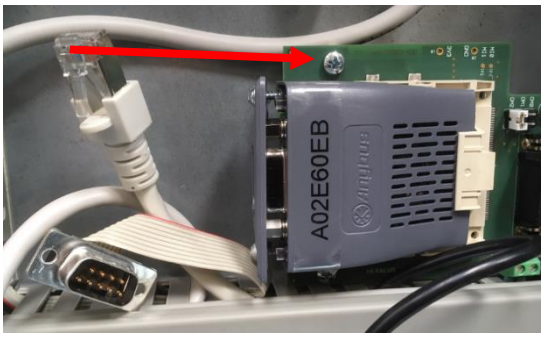
Instrument will come with PCB pre-assembled ready for board installation but without the board

UCS number for options	UCS
CASTEMP WL PROFIBUS DP OPTON KIT	33201079
CASTEMP WL ETHERNET IP OPTON KIT	33201080

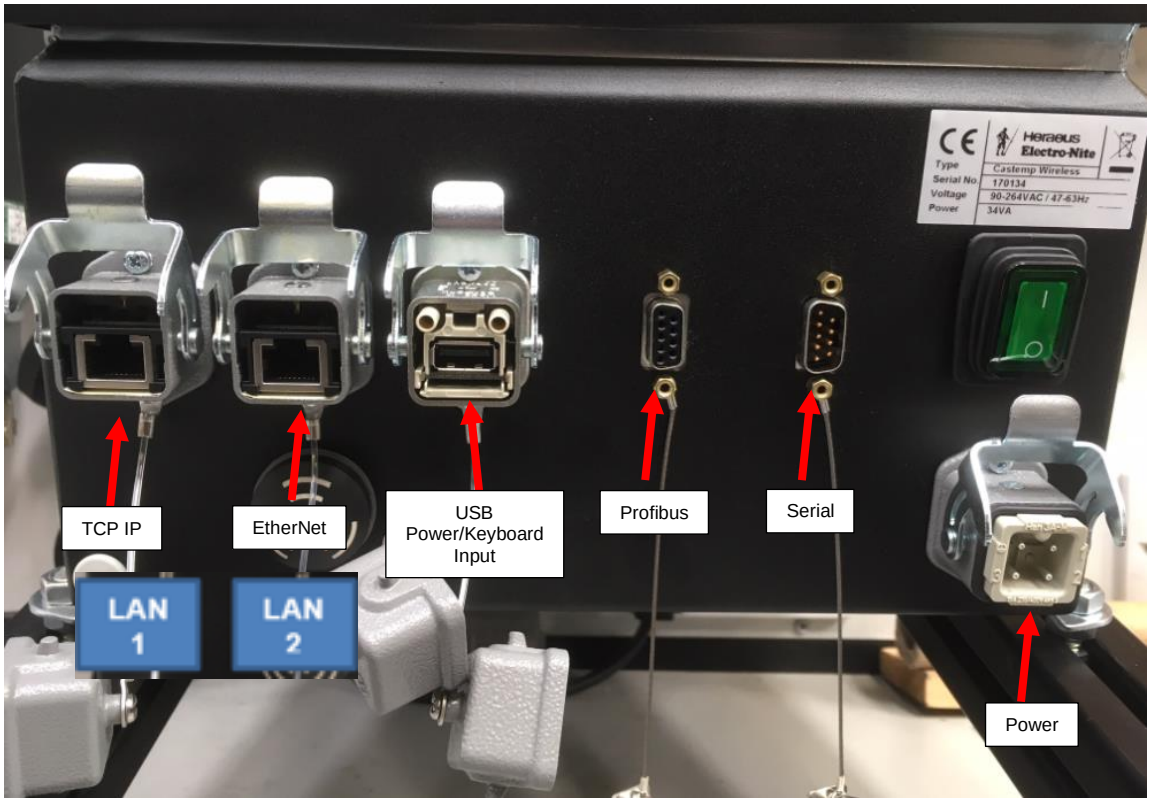


Profibus card or EtherNet card can be connected to the PCB board, connection is same for both boards but difference cables are required, as shown above. Please note screws must be loosened as shown in the example before trying to fit the option card.

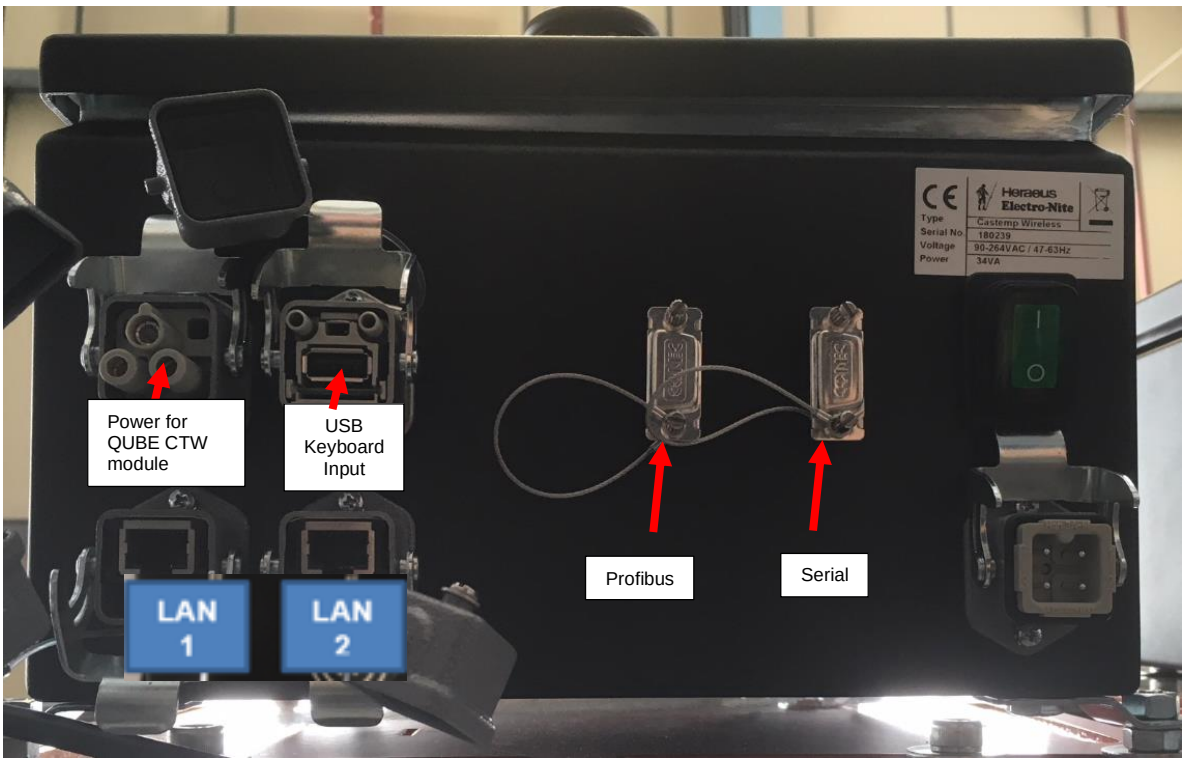
Tighten the screws with a T8 driver to secure the board and connect the relevant lead



Connect the customer’s plant connection to the relevant connection on the outside of the instrument.



1st edition model CasTemp Wireless Instrument



2nd edition model CasTemp Wireless Instrument

10.5 Appendix 5: CasTemp approval form

CasTemp installation

I confirm the CasTemp system has been installed and commissioned in line with the CasTemp installation manual. ☐

CasTemp Wireless installation

I confirm the CasTemp Wireless system has been installed and commissioned in line with the CasTemp Wireless installation manual. ☐

Instrument Serial Numbers

CasTemp Superheat Licence Approval

I confirm Heraeus Electro-Nite provides the ‘CasTemp Superheat‘ System and the respective measurements (measurement of the superheat via CasTip, calculation of the superheat and the forward prediction of the superheat at the end of the cast) on an advisory basis and will not be liable for any inaccurate results. ☐

Name:

Position:

Customer name:

Address:

Customer signature: HEN signature:

Date: Date:

10.6 Appendix 6: QUBE CTW Module Repair Guide

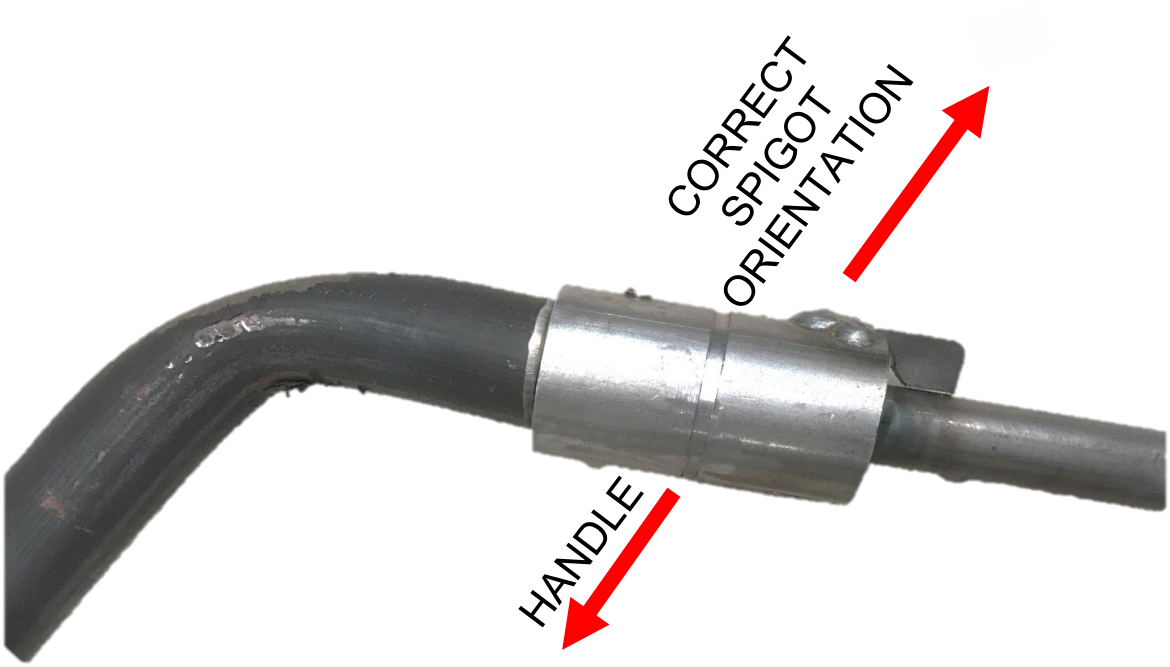
no	Assembly UCS	Spare	Description	Repair Guide
0	31715004	Spare	CTW battery lead assembly	not field repair
1	31970002	Return for repair	Qube CTW Battery Pack	***module***
2	31970000	Return for repair	Qube CTW battery Housing assy (Harting)	***module***
3	31715003	Return for repair	Qube CTW switch Assembly	not field repair
4	31715002	Spare	Antenna Assembly	not field repair
6	31980208	Spare	Antenna Replacement	***module***
5	31715001	Return for repair	Qube CTW PCB Housing assy	not field repair
7	31100155	Spare	Qube CTW	***module***
8	20837661	Spare	QUBE CTW MODULE ASSEMBLY(PACK)	***module***
9	22814121	Spare	CTW MODULAR HEAD ASSEMBLY	not field repair
10	22833721	Spare	CTW SIGNAL CABLE ASSY 1.76M	***signal cable***
11	21822321	Spare	QUBE CTW SIGNAL CABLE ASSY 1.5	***signal cable***
12	20837721	Spare	QUBE CTW SIGNAL CABLE (1.5M)	***signal cable***
13	20837861	Spare	QUBE CTW TOOL KIT	not field repair

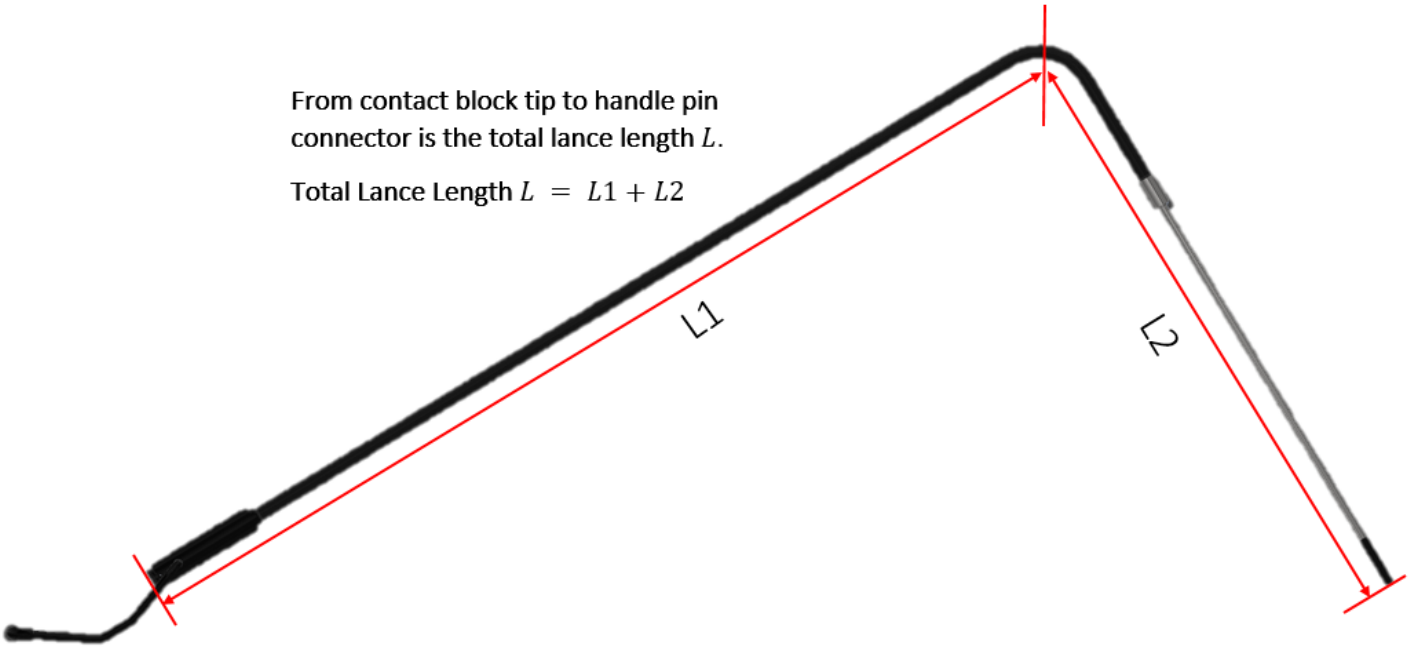
For detailed procedures and parts, please see your HEN representative.

10.7 Appendix 7: QUBE CasTip Lance Build Guide

IMPORTANT

ENSURE THAT THE SPIGOT IS FIXED FACING AWAY FROM THE OPERATOR TO AVOID DRAINAGE OF SAMPLE CHAMBER





Probe Holder length= 903mm

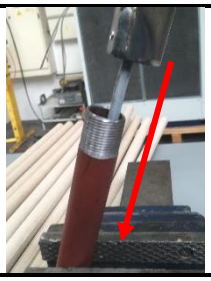
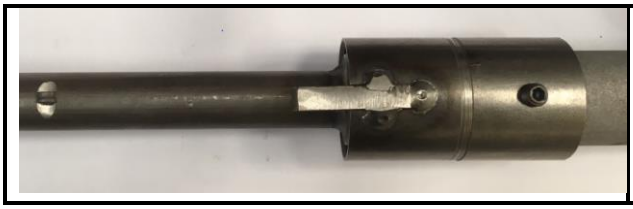
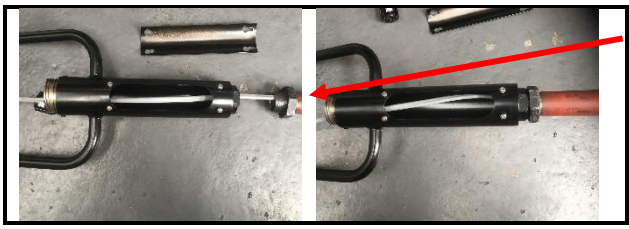
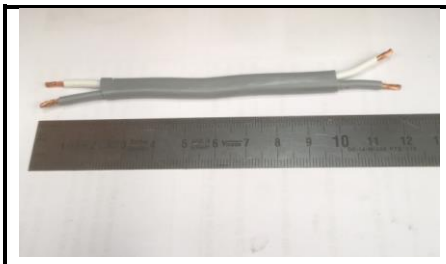
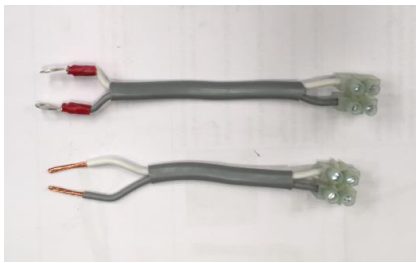
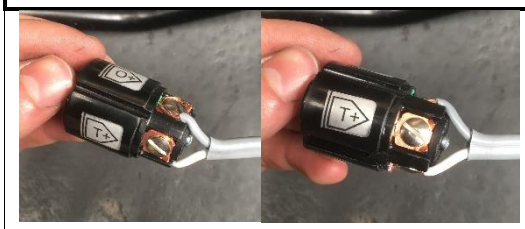
Parts Required			
CASTIP LANCE HOLDER + CTB + CABLE P1 (including 4m 2 core Cu-Cu signal cable) - NOTCHED	1	PC	20850960
M.S. TUBE 1.1/16” O.D.X 10SWG (Steel Tube)	L-1.1	M	23910221
HANDLE W/CVR W/CONN FEM 4P NON-COMP (Lance Handle)	1	PC	39800017
¾’’ BSP M.I LOCKNUT	1	PC	24006511
INSULATION TAPE BLACK	0. 4	M	24014211
Red crimp type 1-4L 22-16 (suitable for 4mm stud)	2	PC	RS 267 3622 or similar
Terminal block (2 segments of 12) nylon 2.5mm^2 250V	2/12	PC	RS 464-9744 similar

Tools Required

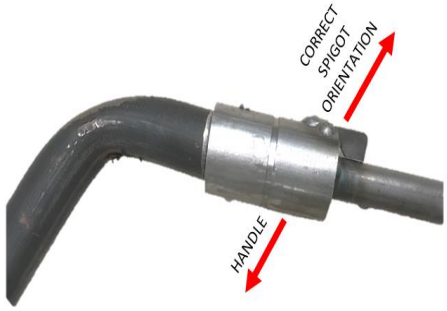
- Wire Cutters
- Stilsons
- Knife
- Philips and Flat Head Screw Driver
- Tube Threading Machine W/ ¾ BSPT Die
- Tube Bender
- 3mm Allen key
- Digital Multimeter
- Cable stripper
- Crimping tool

	Take the tube which has been cut to length and thread 40mm of each end to ¾ BSPT. Make sure to clean the inside of the tube free of swarf and burrs to which could damage the cable.

	Bend the tube to the desired angle for the application. For more aggressive bends the tube may need to be over bent as it may spring back a small amount.

	Feed the cable through the steel tube and hand tighten the probe holder onto the tube thread.
	Note the design of the probe holder: • Locate the spigot to be facing upwards. • Grub screw which bites onto the pipe thread to prevent rotation of the probe holder.
	Attach the ¾" BSP lock nut to the steel tube and feed the cable through the lance handle. Then hand tighten the lance handle onto the tube.
 	**Flying lead** To simplify replacement of the probe holder / cable assembly for the future, it is expedient to attach a short flying lead to the Russel-Stowe (R-S) connector which attaches to the probe holder cable via a terminal strip Cut the cable 120mm of cable from the probe holder and cable assembly. Strip back the outer insulation 20mm minimum each end and strip the cable by 5mm minimum. Fix the terminal strip to one end of the cable Option 1: (preferred if equipment is available) Fix the crimps to the exposed conductors preferred with the cable sides facing Option 2: Strip the outer insulation to 40mm and strip the conductors to 20mm
	Attach the flying lead to the R-S connector. **GREY CABLE (+) to O+** **WHITE CABLE (-) to O-** For Option 1, remove the terminal screws and fit the crimp terminals For Option 2, wrap the copper wire clockwise under the head of the terminal screw, and tighten, ensuring that it is held securely with no exposed wire strands

	Tape one wrap around the connections with electrical tape and replace the R-S connector into the lance in the correct orientation. Note the orientation of the contacts and grooves, +O and +T should be visible.

	**Final Assembly** Tighten screws on each side of the handle to secure the insert. Tighten the ¾ BSP lock nut on handle so handle is perpendicular to the bend of the tube.
	Connect the flying lead to the cable and fold the cable inside the handle through the access hatch if needed. **Turn the probe holder so that the spigot <u>is facing away</u> from the handle. Tighten grub screw down securely with Loctite applied.**

Continuity and polarity check	**Connect a paired QUBE CasTip to the handle and Checkmate or similar close circuit device to the probe holder**
+T to –T via close circuit	2 green LED's illuminated, full measurement sequencing (green amber red amber red)
Isolation checks	**Lance open circuit with no sensor connected, tested at pins**
Each of **+T/+O/-T/-O** to each other and to ⏚	∞ or >999 MΩ
+T or –T contact block to +T pin or –T pin	∞ or >999 MΩ
+O or –O contact block to +O pin or –O pin	~<2Ω